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DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION SPECIFICATION

ARTS IIIE SYSTEM FUNCTIONAL

SPECIFICATION

April 15, 1994

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1. SCOPE.

1.1 Scope. This specification establishes the performance, design, development, and test requirements for the ARTS IIIE System.

The objectives of the ARTS IIIE are to:

a. Expand present system to meet the Air Traffic Control (ATC) needs beyond the end of this century.

b. Provide a system which can be modularly expanded without change to delivered certified hardware or software.

ARTS IIIE shall be installed at new and existing FAA facilities. The ARTS IIIE facility will communicate, in real time, with the En Route Center and with Government systems necessary to accomplish ATC functions. The ARTS IIIE support system at FAATC shall be baselined so as to be identical to the ARTS IIIE system except for the number of displays.

The specification is organized in accordance with MIL-STD-490, Appendix I. Performance characteristics are described in paragraph 3.2.1; functional area characteristics are defined in paragraph 3.7.

2. APPLICABLE DOCUMENTS.

2.1 FAA Specifications. The following specifications, standards, orders, and handbooks, including all modifications and amendments, form a part of this specification and are applicable to the extent specified herein.

2.1.1 Reference Documents. The documents in this paragraph are provided as reference material for background information only.

2.1.1.1 Specifications.

2.1.1.1.1 Federal Aviation Administration.

FAA-G-1210	Provisioning Technical Documentation
ARTS IIIE NAS-MD-631	NAS En Route - ARTS IIIE
ARTS IIIE NAS-MD-632	Conflict Alert Adaptation and Guidelines
ARTS IIIE NAS-MD-633	Standards for Defining and Adapting Values for MSAW Site Variable Parameters
ARTS IIIE NAS-MD-634	System Description and Specified Series
ARTS IIIE NAS-MD-635	Multiprocessing Executive (MPE)
ARTS IIIE NAS-MD-636	Beacon/Radar Input Processing
ARTS IIIE NAS-MD-637	Target Processing (Tracking) & ISL
ARTS IIIE NAS-MD-638	Keyboard Input Processing
ARTS IIIE NAS-MD-639	Display Output Processing
ARTS IIIE NAS-MD-640	Interfacility Data Transfer
ARTS IIIE NAS-MD-642	CDT Nonexecutive Error & Status Messages
ARTS IIIE NAS-MD-643	Site Adaptation
ARTS IIIE NAS-MD-644	MSAW and Altitude Tracking
ARTS IIIE NAS-MD-645	Nonexecutive Console Teletype Input Processing and On-Call Tasks
ARTS IIIE NAS-MD-646	Builder, BUP and CDR editor, Retrack and SMC Support Software
ARTS IIIE NAS-MD-647	Recovery
ARTS IIIE NAS-MD-648	Continuous Data Recording
ARTS IIIE NAS-MD-649	Remote Display Processing
ARTS IIIE NAS-MD-650	Support Software, Sir-Cinos Executive
ARTS IIIE NAS-MD-650A	Support Software Ultra Assembler
ARTS IIIE NAS-MD-650B	Librarian

ARTS IIIE NAS-MD-650C	Support Software Loader
ARTS IIIE NAS-MD-650D	Utilities
ARTS IIIE NAS-MD-650E	Support Software CONIOP
ARTS IIIE NAS-MD-651	System Monitor Console
Tampa/Sarasota - NAS-MD-636A	Remote SRAP
Tampa/Sarasota - NAS-MD-639	Display Output Processing

2.1.1.2 Military. None

2.1.1.3 Other Documents. None

2.1.2 Standards.

2.1.2.1 Federal Aviation Administration

FAA-STD-002c	Engineering Drawings
FAA-STD-010c	Graphic Symbols for Digital Logic Equipment

2.1.2.2 Military.

MIL-STD-471	Maintainability Verification Demonstration and Evaluation
MIL-E-17555H	Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts); Packaging and Packing of
MIL-STD-188C	Military Communications System Technical Standard
MIL-STD-490	Specification Practices
MIL-STD-1388-2A	Integrated Logistics Support

2.1.2.3 Other Documents.

FIPS PUB 38	Guidelines for Documentation of Computer Programs and Automated Data Systems
ICAO ANNEX 10	Aeronautical Telecommunications, International Standards, Recommended Practices and Procedures for Air Navigation Services, and Convention on International Civil Aviation
NEC	National Electric Code
FAA Order 1370.14A	Flow Chart Symbol Standard
FAA Order 1600.6	Protection of Agency Property
FAA Order 1600.54	Security of FAA Automatic Data Processing Systems and Facilities
FAA Order 3000.6	Training
FAA Order 7110.65	Air Traffic Control
FAA Order 7110.80	Data Communication
FAA Order 7210.3G	Facility Operation and Administration Handbook (FAA)
NAS-81-0056	Terminal System Support Facility Handbook (April 1981)
NAS-81-0040	Air Traffic Simulation Facility Users Guide (December 1979)
Federal Aviation	Special Use Airspace
Federal Aviation	General Operating and Flight Rules
ATC-21000	ATC Hardware Design Data
CFR	Property Management Regulations, Part 101
ICAO Annex 10	Vol. I Aeronautical Telecommunications (3rd edition), July 1, 1972, Part I Equipment Systems, Part II Radar Frequencies
ICAO Annex 10	Vol. II Aeronautical Telecommunications (Communications Procedures)
FAA-GFP-130-001	Government Furnished Property

2.2 Compliance Documents. The documents in this paragraph are applicable to the extent specified herein.

2.2.1 Specifications.

2.2.1.1 Federal Aviation Administration.

FAA-G-2100e	Electronic Equipment, General Requirements
FAA-E-2747	Full Digital ARTS Display (FDAD)
FAA-E-2704	ASR-9 Specification
FAA-G-1375c	Spare Parts - Peculiar for Electronic, Electrical, and Mechanical Equipment

2.2.1.2 Military.

MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities

2.2.1.3 Other Documents.

GTA-62-8-7	Glass Tempering Association Specification

2.2.2 Standards.

2.2.2.1 Federal Aviation Administration.

FAA-STD-012a	Color and Texture of Finishes for National Airspace System Equipment
FAA-STD-016a	Quality Control System Requirements
FAA-STD-020	Transient Protection, Grounding, Bonding and Shielding Requirements for Equipment
FAA-STD-018a	Computer Software Quality Program Requirements
FAA-STD-021a	Configuration Management (Contractor Requirements)
FAA-STD-025	Preparation of Interface Control Documents

2.2.2.2 Military.

MIL-STD-280A	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-454H	Standard General Requirements for Electronic Equipment
MIL-STD-461B	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-470A	Maintainability Program Requirements (for Systems and Equipments)
MIL-STD-483	Configuration Management Practices for Systems, Equipment, Munitions, and Computer Software
MIL-STD-721C	Definitions of Terms for Reliability and Maintainability
MIL-STD-781C	Reliability Design Qualification and Production Acceptance Tests: Exponential Distribution
MIL-STD-785B	Reliability Program for Systems and Equipment Development and Production
MIL-STD-1472C	Human Engineering Design Criteria for Military Systems Equipment and Facilities
MIL-STD-1474B	Noise Limits for Army Material
MIL-STD-1521B	Technical Review and Audits for Systems, Equipment, and Computer Software

DOD-STD-480A	Configuration Control - Engineering Changes, Deviations and Waivers
DOD-STD-2167A	Defense System Software Development

2.2.3 Other Documents.

FAA Order 1350.22	Protecting Privacy of Information About Individuals
FAA Order 4660.1	Real Property Handbook
FAA Order 6000.15	General Maintenance Handbook for Airway Facilities
FAA Order 6000.27A	Transmittal of Maintenance Philosophy Steering Group (MPSG) Report
FAA Order 6000.30	Airway Facilities Service Policy Decisions for the Maintenance Program of the 1980's
FAA Order 6480.7	Airport Traffic Control Tower and Terminal Radar Approach Control Facility Design
FAA Order 6950.15	Critical Power for ARTCC's for Testing
FAA-D-2494/1	Technical Instruction Book Manuscripts: Electronic Equipment
Fed STD-595	Colors
CFR	Title 10, Code of Federal Regulations, Part 40
CFR	Schedule A, Title 10, Code of Federations, Part 30
MIL-HDBK-472	Maintainability Prediction
NASP-5204-01	Volumes I and II
IEEE 802	Institute of Electrical and Electronic Engineer - Local Area Networks International Standards Organization (ISO) Open System Interconnect (OSI) Reference Model and ISO Communication Protocol Standards
PX6196	ARTS III Support Software User's Guide

ANSI/IEEE Standard 344-1975
AT&T Bulletin 326-130, PUB 51001, Issue 2

(ACIA) Contract 10	FAA Technical Center Plot Plan and Architectural Drawings, Atlantic City Improvement Authority, Sheets 106 through 109
(ACIA) Contract 11	HVAC and piping drawing sheets 303 through 806, 320 through 323.
(ACIA) Contract 12	Plumbing Drawings sheets 503 through 506 Sprinkler system Drawing Sheet 603 through 606
(ACIA) Contract 13	Lighting and Power Drawings Sheet 413, 416, 418, 421, 423, 436, 438, 441, 443, 474, 481 through 484.

3. REQUIREMENTS.

The ARTS IIIE system shall provide continuous real time support to air traffic controllers in managing the use of airspace and airports. A System Support Computer (SSC) shall be provided at the FAA Technical Center (FAATC).

From an ATC operational perspective, the requirements appear in paragraph 3.7, Functional Area Characteristics, which specifies what the ARTS IIIE is required to do and 3.2.1, Performance Characteristics, which specifies the volume of data to be processed and the performance levels that are required. Section 3.1 presents an overview of the ARTS IIIE requirements.

3.1 System Definition. This section describes the organization and functions of the ARTS IIIE, its interfaces, and how it fits into the overall Federal Aviation Administration (FAA) organization.

The ARTS IIIE is dependent upon certain other FAA systems to meet its objectives. The ARTS IIIE specification is also written to take advantage of the data provided by the ASR-9 system which is scheduled to be implemented.

Although the specification describes a functional separation of the various subsystems, the CP and the TP may reside in one computer complex. If the CP and TP are combined all system functions and failure mode operations shall still be satisfied as specified herein.

3.1.1 General Description. The ARTS IIIE shall be a functionally distributed system consisting of a Track Processing Subsystem (TP), Common Processing Subsystem (CP), Display Processing Subsystem (DP), and System Monitor Console (SMC).

The ARTS IIIE may consist of both Contractor supplied and Government-Furnished Equipment (GFE). The use of existing processor and memory may be used as part of the ARTS IIIE system to the extent that they meet the availability requirements of this specification.

The TP consists of those hardware and processing/data elements associated with the processing of digitized surveillance data and tracked target processing (Tracking).

The TP receives digitized aircraft beacon and primary target data from surveillance digitizers. The TP uses the target data for correlation with existing tracks or for initiation of new tracks. It smooths the track position and velocity and predicts the track position for the next scan. The TP provides the track and target data to the CP and DP.

The TP major interfaces include, but are not limited to; surveillance digitizers, the CP, the DP, external time source and ARTS IIIE SMC.

The CP consists of those hardware and software elements whose major data processing functions require inputs from several sources outside the CP.

The CP processes track and target data received from the TP, flight plan/handoff data from the ARTCC (via interfacility link) and keyboard data from the DP.

The CP provides data to the ARTCC (via interfacility link) as well as automated outputs to the DP and outputs to other peripheral devices.

The processing functions of the CP include, but are not limited to; Minimum Safe Altitude Warning (MSAW), Conflict Alert (CA), Interfacility Communication Processing (IFC), Automatic Flight Plan/Track Association, Keyboard Processing, and Data Recording (continuous and critical).

The CP major interfaces include, but are not limited to; the TP subsystem, the DP subsystem, interfacility, the ARTS IIIE SMC, recording/recovery hardware, and external time source.

Other functions include training/simulation, a sensor/display reconfiguration capability and an interfacility simulation capability.

The DP consists of those hardware, software and firmware elements associated with the processing and display of ATC related information. Each display element in the DP subsystem shall be independently responsible for its own data base management and refresh its own displayed data. Each display receives ATC related update data from the TP and CP in the form of track and target updates, keyboard responses, CA data, MSAW data, tabular list updates, and system data updates.

Each display formats, validates and transmits its keyboard messages, which require additional processing, to the CP. Those keyboard actions which do not require additional processing in the CP are processed locally in the display.

The DP displays receive surveillance analog broadband data from the radar distribution system. This includes radar azimuth data, triggers, beacon, and primary video.

The DP displays interface with the TP, CP, radar distribution system, and ARTS IIIE SMC.

The ARTS IIIE SMC consists of those hardware, processing and data elements which provide the capability to process and record status, alarm and performance messages which are received from the TP, CP, and DP.

The ARTS IIIE SMC also formats, validates and processes system and subsystem control and configuration keyboard messages which it routes to the appropriate subsystem for action.

The ARTS IIIE SMC interfaces with the TP, CP, DP, and external time source. One SMC shall be located in the operations area and one shall be located in the equipment room area. Both SMCs shall display/printout all system data. The operation room SMC shall normally control the system.

3.1.1.1 System Boundary. The subject of this specification is the ARTS IIIE, which shall include computers, computer programs, displays, storage devices, input devices, output devices, controller and operator workstations, interconnecting communications, supporting maintenance, logistics, training subsystems, and interfaces with other appropriate entities.

The ARTS IIIE does not include any voice communications nor any equipment at surveillance sensor sites. The ARTS IIIE shall interface with remote tower cabs displays and other NAS facilities. The ARTS IIIE shall not interface with any of the ATC or ATC-related functions performed by the Flight Service Stations (FSSs), Traffic Management System Facility, Airport Reservations Office (ARO), Central Altitude Reservation Facility (CARF), National Flight Data Center (NFDC), Remote Maintenance Monitoring System (RMMS), or ATC Command Center.

3.1.1.2 Functional Areas. The Functional Areas of the ARTS IIIE are:

a. Normal Processing: The normal processing mission of the system includes radar input processing and tracking, display processing, and common automation functions found at ATC facilities.

b. Data Entry and Display: The requirements for Controller and Supervisor (other than maintenance) positions includes console hardware and related data processing for display presentation and controller input message make-up.

c. Modes of Operation: The required 5 modes of operation at the ARTS IIIE are as follows:

(1) Normal Mode - The normal mode is all operational functions and off-line support functions simultaneously performed without conflict.
(2) Fail Safe Mode - The fail safe mode is all operational functions being performed with redundant hardware.
(3) Fail Soft Mode - The fail soft mode is operation with some loss of functional capability.
(4) Backup Mode - The backup mode is operation with the loss of CP functions.

(5) Broadband Mode - The broadband mode is loss of all automation functions.

Throughout the remainder of this specification Normal, Failsafe, Failsoft, and Backup modes shall be considered automation modes. The Fallsafe and Failsoft modes shall apply only to the TP subsystem. The Failsoft mode's functional loss shall be limited to the automatic initiation of radar only tracks in the TP subsystem. Broadband mode shall be considered a nonautomation mode.

d. Support and Training: The requirements to support system operation at the facility level, and at the FAATC, to train FAA personnel.

e. Diagnostic and Repair: The requirements to support hardware and software maintenance at the facility level.

f. System Testing and Verification Support: The requirements to support testing of hardware and software modifications.

g. System Build and Site Adaptation: The requirement that the capability of assembling and building programs be available at the FAATC. The assembly/build of the IOP-based programs shall be conducted on the Stand-Alone Assembly System (SAAS) located at the FAATC.

The SSC must meet all the functional requirements of the ARTS IIIE, plus the additional requirements of Table 3.1-1 below.

a. System Modification: The requirements for centralized support of software and hardware modifications.

b. Field Support: The requirements to provide centralized support to facility level hardware and software.

Table 3.1-1. Assignment of Functional Areas to ARTS IIIE Computer Complex.

FUNCTIONAL AREAS	ARTS IIIE	SSC
Normal Processing	X	X
Data Entry and Display	X	X
Modes of Operation	X	X
Support and Training	X	X
Diagnostic and Repair	X	X
System Modification		X
System Testing and Verification Support	X	X
Field Support		X
System Build and Site Adaptation	X	X

3.1.1.3 Configuration, Modes, and Resource States. The following definitions apply:

a. Configurations: At the ARTS IIIE location, the collection of hardware and software resources that is being applied to operational control of air traffic is said to constitute the ATC Configuration. All other hardware and software resources at the location are said to be in the NonATC Configuration.

b. Modes: The ATC Configuration of the ARTS IIIE shall be in one of

to be in the Maintenance Mode. Additional Modes of the NonATC Configurations may be defined in the ARTS IIIE design as appropriate.

c. Resource States: Any ARTS IIIE hardware or software resource that is being applied to operational control of air traffic - that is, all those resources that together form the ATC Configuration - is said to be in the On-Line State. Any ARTS IIIE hardware or software resource that is in the process of being maintained and is not available for any other use is said to be in the Down State. All other ARTS IIIE hardware and software resources are said to be in the Standby State.

3.1.2 Mission. The mission of the ARTS IIIE shall be to provide automation support to large, multisensor ATC terminal facilities.

The prime mission of the ARTS IIIE shall be to provide automated support to air traffic controllers and to support continued system growth in function and capacity. Specifically, the ARTS IIIE mission shall be to provide uninterrupted automated assistance to:

a. The maintenance of safe separation between aircraft and obstructions or special use airspace.

b. The maintenance of an orderly and efficient flow of air traffic with minimum interference with pilot intent.

c. The collection of flight safety information and its dissemination to controllers and pilots.

3.1.3 External Constraints. The traffic demand on the ATC System is expected to continue to grow. The existing automation systems cannot meet this need. A new system with greater capacity, is needed.

3.1.3.1 Traffic. Significant growth per year in air traffic operations is projected. This growth in traffic will present two challenges to the ARTS IIIE. The first will be to expand the processing power of the system to cope with the higher loads. The second will be to expand the functional capability of the system in order to maintain or improve system safety and efficiency.

3.1.3.2 Service To Users. Continually increasing costs, especially for fuel, have placed new importance on improving the efficiency of flight. Toward this end, aircraft owners are investing in area navigation and flight management systems.

The functionality of the ATC System must expand and improve to support the goals of more efficient flight and to take advantage of new airborne and navigation capabilities.

3.1.4 System Diagrams. The ARTS IIIE shall be a functionally distributed processing system. Figure 3.1-1 illustrates a method for distributing the functions of the ARTS IIIE.

The DP function is responsible for preparation of display data for presentation on the corresponding controller displays. The DP is also responsible for determining and sending appropriate controller entries to the CP for action.

The TP function is to receive target reports (radar, beacon, and radar reinforced beacon) from the digitizers. The TP receives the target reports from the digitizer for all sensors and maintains a track file for each track.

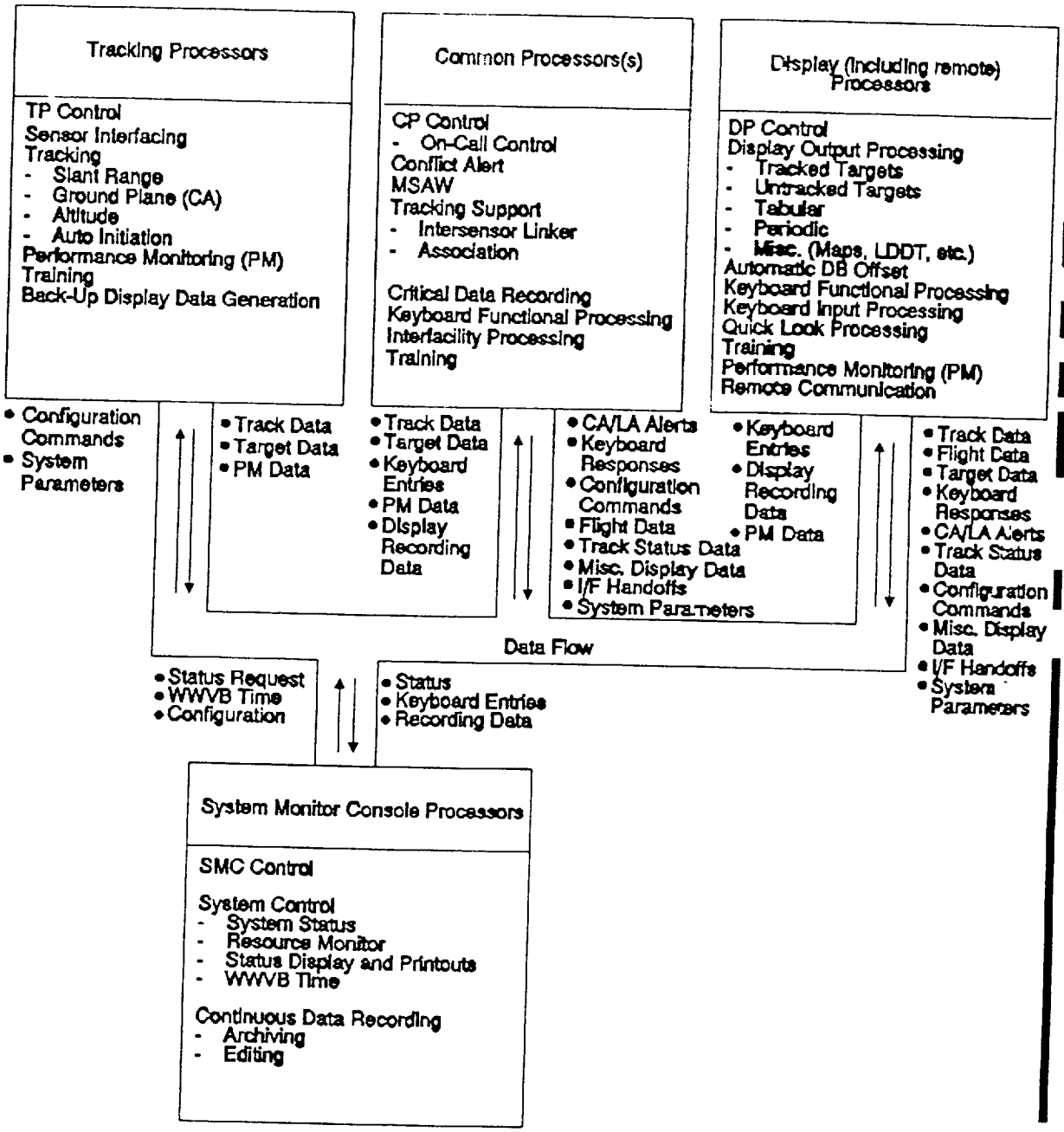


Figure 3.1-1 Distributed Approach Functional Allocation and Data Flow

It provides tracked target data which are sent to the CP and/or DP. Tracks are maintained for each sensor, and all targets for each sensor tracked or untracked are outputted.

The CP functions are those functions which require a global view of the data base. For example, these functions include association of Flight Plan data with track data and intersensor linking.

The SMC monitors and displays system status. It also provides the continuous data recording for the system.

3.1.5 Interfaces. Various communication interfaces or links are used throughout the FAA to facilitate the exchange of information among facilities.

3.1.5.1 Operational Interfaces. Interfaces to equipment that will be collocated with the ARTS IIIE, as well as interfaces to equipment and computer systems external to the ARTS IIIE system, are identified in Section 10. Figure 3.1-2 presents an interface architecture that will serve the ARTS IIIE.

3.1.6 Physical Characteristics. The largest component of the ARTS IIIE is the input/output processor, model B (IOPB) installed in a processor cabinet (PCAB) with a solid state memory unit (SMU). The principal physical characteristics of this unit are:

Height:	70.4 inches
Width:	37.3 inches
Depth:	25.5 inches
Weight:	1120 pounds
Floor Space:	6.7 square feet
Rear Clearance:	47.0 inches
Input Power:	
Voltage:	120 volts
Frequency:	60 Hz
Phase:	1
Power:	3.22 Kw
Type:	Critical
Heat Generated:	10,978 BTU/hour
Temperature Tolerance:	Low 50°F; High 90°F
Humidity Tolerance:	Low 20% Relative; High 80% Relative

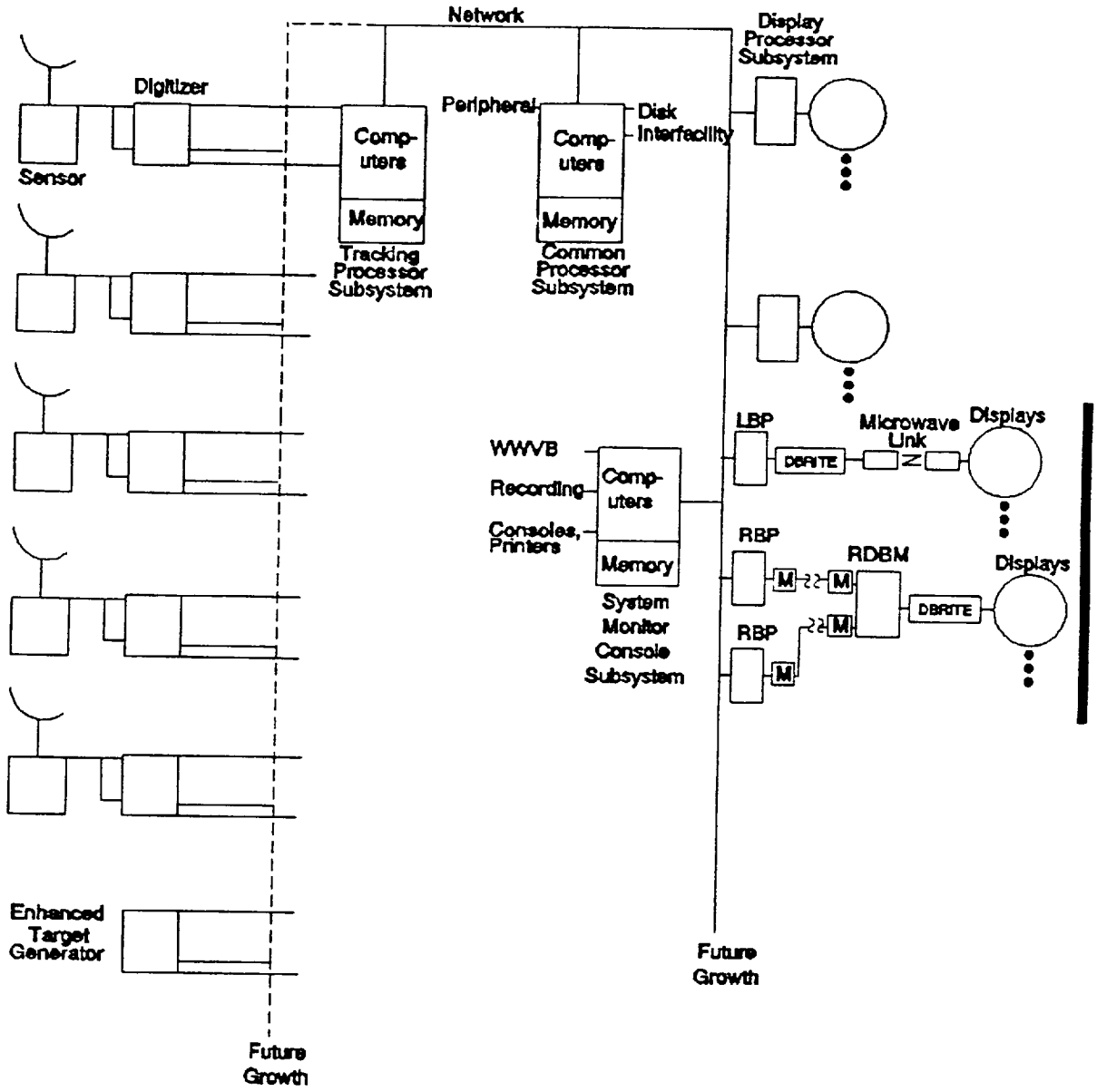
3.1.7 Operational and Organizational Concepts.

3.1.7.1 Operational Concept. The ARTS IIIE will not introduce conceptual changes to ATC. Rather, it will expand the current tracking capacity of the present ARTS IIIA system to support ATC requirements beyond the year 2000.

The ARTS IIIE shall provide new contractor developed controller data entry and display hardware and software which is transparent to the controller. It is intended that the surveillance displays shall be evolutionary descendants of the existing displays, but with many improvements, especially in the presentation of digitized data. ARTS IIIE controller input devices shall make best use of current technology.

3.1.7.1.1 ARTS IIIE. The ARTS IIIE shall expand the ARTS IIIA system beyond its current hardware limitations, and improve the presentation of digitized display data in the control room. The ARTS IIIE will receive new displays capable of both full digital and time share mode.

3.1.7.1.2 Modes of Operation. There will be 4 modes of automation operation and 1 mode of nonautomation, reference paragraph 3.1.1.2 c for definitions.



DBRITE = DIGITAL BRITE INDICATOR TOWER EQUIPMENT
RDBM = REMOTE DISPLAY BUFFER MEMORY
M = MODEM

3.1-2. Interface Architecture ARTS IIIE

3.1.7.1.3 System Support Computer (SSC). This Computer will be located at the FAATC. Its purpose shall be to support the ARTS IIIE operations by providing a place where modifications and corrections to the operational systems can be developed and tested. Therefore, it shall be physically and functionally identical to the field ARTS IIIE configuration (except for the number of displays and keyboards), and shall be capable of being maintained to the same revision level . The contractor shall provide the capability to simulate the display, keyboard and interfacility load on the FAATC ARTS IIIE.

3.1.7.2 Organizational Concept.

3.1.7.2.1 Administrative Organization. The FAA is a decentralized Agency. Field facilities are under the administrative control of nine regional offices. The SSC will be administered by the FAATC, under the direction of the Associate Administrator for Development and Logistics.

3.1.7.2.2 Relationship of the SSC System. Although FAATC will house, maintain, operate, and provide physical plant support for the SSC system, the using organizations will be a detachment of the Program Engineering and Maintenance Service and the Air Traffic Services which will report to their service headquarters in Washington.

The SSC will provide direct field support for diagnosis and correction of hardware and software trouble reports and provide consultation to the field site. All releases of hardware and software will be made from the SSC. The SSC will be maintained at the revision level of the field.

3.1.8 Transition Requirements. This specification does not state all system requirements necessary to transition the system into operational use. The statement of work contains an overview of the transition process and states requirements which are to be complied with in the transition process.

3.2 Characteristics. This paragraph establishes the quantitative and qualitative requirements which the ARTS IIIE must meet. It specifies the message volumes and response times associated with each message which, in conjunction with the functions described in paragraph 3.7, will serve as a basis for determining overall system sizing. It specifies Reliability, Maintainability, and Availability (RMA) requirements which will determine the ability of the ARTS IIIE to meet its ATC mission safely.

3.2.1 Performance Characteristics. The ARTS IIIE shall be capable of providing the ATC functional services specified in paragraph 3.7 for the projected ATC workload within a designated volume of airspace. In providing these functional services, the ARTS IIIE shall be capable of servicing the input data from and producing the output data for the remote and local facilities and control operations personnel with which the ARTS IIIE communicates. These requirements are specified as follows for each system type:

a. Design Limits specify the maximum values of selected parameters. The system shall accommodate any of these parameters being set to its design limit without any change to the computer program code. Also, specified response times shall be met when processing with any of these parameters being set to its design limit.

b. The technique that is used to specify system-level workload and response time requirements is as follows: specified response times for designated stimulus-response pairs shall be met when processing a specified maximum stress workload for a system. The maximum stress workload corresponds to peak traffic together with

the most demanding environmental conditions. The definition of the system workload specifies the frequencies of messages and the system environment.

c. The accuracy achieved by the ARTS IIIE is dependent on the accuracy of the input data that will be provided to the system. The nominal characteristics of the input data are stipulated herein. The ARTS IIIE shall achieve its specified performance when processing input data that meet the stipulated characteristics.

3.2.1.1 Terminology. The specification of ARTS IIIE performance, like the functional requirements of paragraph 3.7, in many cases uses the terminology of the existing FAA automation system. There is no intent to require that the identical terminology must be utilized by the ARTS IIIE.

3.2.1.1.1 Design Limits. The ARTS IIIE has jurisdiction over an allocated volume of airspace. The parameters listed in Tables 3.2-2 and 3.2-3 describe elements of the environment and airspace definition which shall be accommodated in the ARTS IIIE.

Table 3.2-2. ARTS IIIE System Design Limits

DESIGN SOURCES AND DESTINATIONS	LIMIT	
Surveillance Systems	6	
Displays TRACON	58	
Interfacility Communications	3	
Remote Displays Systems	18	
Remote Keyboards	3	per remote system
Maximum Keyboards/System (any mix)	127	

Table 3.2-3. ARTS IIIE Design Limits-Airspace Definition

DESIGN DATA ITEM	LIMIT	
TRACON Area (i.e., area for which track data must be available for each sensor)	60	nmi radius/sensor
Tracks (includes flight plans)	3400	
Tracks per sensor (maximum)	600	

3.2.1.1.2 Capacity and Response Time. This paragraph specifies the capacity and response time requirements that the ARTS IIIE as a whole shall meet. The system capacity is described in paragraph 3.2.1.1.2.1. The allowable delay between receipt of a given message and the generation of the appropriate response, while processing the specified capacity, is specified in paragraph 3.2.1.1.2.2.

3.2.1.1.2.1 Capacity. Table 3.2-4 specifies the capacity in terms of rates of entry of selected input messages. (Those input messages whose frequencies are not listed in Table 3.2-4 either occur so seldom as to have negligible effect on system load, or are such that their frequency is determined by other requirements).

Table 3.2-4. ARTS IIIE Capacity Message Rates

Surveillance Inputs (Per Sensor/Per Scan)	
Radar Only Targets	100
Beacon/Radar Reinforced Targets	500
Primary Noise	50

3.2.1.1.2.2 Response Times. The ARTS IIIE shall meet the response time requirements specified in Table 3.2-5. These response times shall be satisfied under maximum capacity conditions for all modes of operation and represent average values.

Table 3.2-5. ARTS IIIE Response Times

For local displays, the ARTS IIIE system shall meet the response times specified below. These response times shall be satisfied under capacity conditions for all modes of operation and represent average values. Local displays are TRACON displays.

Message Source	Message Type	Exhibit Of Output Message On Display
Controller	Keyboard	1.2 seconds
Controller	Preview	0.1 second
Controller	Data Readout	0.5 second
Controller	Data List Relocate	1.2 seconds
Controller	Quick Look	1.2 seconds
Controller	Trackball	0.25 second
Controller	Data Change	0.5 second
Radar	Associated Track	1.2 seconds
Radar	Unassociated Track	1.2 seconds

For remote displays, the ARTS IIIE system shall meet the response times specified below. These response times shall be satisfied under capacity conditions for all modes of operation and represent average values. Remote displays are local DBRITE displays with monitor and keyboard located in remote towers and remote DBRITEs.

Message Source	Message Type	Exhibit Of Output Message On Display
Controller	Keyboard	1.8 seconds
Controller	Preview	0.3 second
Controller	Data Readout	1.1 seconds
Controller	Data List Relocate	1.8 seconds
Controller	Quick Look	1.8 seconds
Controller	Trackball	0.3 second
Controller	Data Change	1.1 seconds
Radar	Associated Track	1.5 seconds
Radar	Unassociated Track	1.5 seconds

The automatic offset of display data block leaders shall be performed at least once every radar scan.

3.2.1.1.3 Specific Functional Area Requirements.

3.2.1.1.3.1 Normal Processing. Surveillance targets will not necessarily be distributed uniformly around the radar site. The Target Data Processing and

Automatic Tracking Capabilities shall support the facility capacity and response times specified in Tables 3.2-4 and 3.2-5 under conditions of bunching of target reports as follows:

Number of radar only targets, each sensor	100/scan
Number of false radar targets each sensor in addition to the number of radar targets of item above	50/scan
Number of beacon and radar reinforced beacon targets (all Mode C) each sensor	500/scan
180-degree Bunching	480 targets* within a 180-degree.
11.25-degree Sector Bunching	40 targets* within each 11.25-degree sector for each sensor.
3 Consecutive sectors	100 targets* for each sensor.

* includes radar, beacon and radar reinforced.

These requirements shall be met while processing the capacity specified in paragraph 3.2.1.1.2.1.

3.2.1.1.3.2 Data Entry and Display. Data Entry and Display response time requirements are addressed at the system level in paragraph 3.2.1.1.2.2.

The ARTS IIIE shall display, simultaneously at each control position, the quantity of data for each type display as specified in Tables 3.2-6A,B.

3.2.1.1.3.3 System Monitor Console (SMC). The SMC shall provide a centralized location for the presentation and hard copy recording of all system/subsystem status, alarms, alerts, and performance data. Recording and display of actions taken within the overall system which affect the operation are also included.

The SMC shall provide system control capabilities. SMC keyboard entries shall provide system startup/restart capability as well as selection/deselection of system functions, such as; on-calls, and hardware diagnostics. The capability of enabling/disabling peripherals, system and subsystem elements shall also be provided, as well as system resource and configuration entries.

The SMC shall route specific message type(s) to a separate printer for hardcopy recording.

Response time for the SMC functions are presented in Table 3.2-7.

Table 3.2-6A. FDAD Timeshare Display Model

DATA TYPE	DATA DESCRIPTION	QUANTITY*
MSAW/CA Data Blocks	3-Line Full Data Blocks (FDB) Line 0 - 8 characters Line 1 - 8 characters Line 2 - 9 characters	10
Full Data Blocks	2-Line Full Data Blocks Line 1 - 8 characters Line 2 - 9 characters	40
Limited Data Blocks	Limited Data Blocks (LDB) Line 1 - 6 characters Line 2 - 7 characters	140
Single Symbols	Aircraft Position Symbols (Present)	410
Single Symbols	Unused Target Reports (dot symbol)	100
Vectors (unblanked)	Weather (nonconnecting radial vectors, average 2 inch)	200
Vectors (unblanked)	Map (average 3 inches) 50 head-ttail vectors 50 nonconnecting vectors	100
Circles	Range Rings (at 5 nmi increments)	12
Circles	Other (average 4 inch diameter)	5
Map Symbols	6 of each symbol shown in Figure 3.7-10	36
Tabular Lines	Lines of 19 characters/line	2
Tabular Lines	Lines of 18 characters/line	20

*This display model is for the purpose of demonstrating display capacity and does not imply limits on the various data types.

Table 3.2-6B. FDAD All Digital Display Model

DATA TYPE	DATA DESCRIPTION	QUANTITY*
MSAW/CA Data Blocks	3-Line Full Data Blocks (FDB) Line 0 - 8 characters Line 1 - 8 characters Line 2 - 9 characters	10
Full Data Blocks	2-Line Full Data Blocks Line 1 - 8 characters Line 2 - 9 characters	30
Limited Data Blocks	Limited Data Blocks (LDB) Line 1 - 6 characters Line 2 - 7 characters	130
Single Symbols	Aircraft Position Symbols (Present)	430
Trail Dots	Aircraft History Trail dots (2 with each data block and aircraft position symbol)	1200
Single Symbols	Unused Target Reports (dot symbol)	100
Vectors (unblanked)	Weather (nonconnecting radial vectors, average 2 inch)	200
Vectors (unblanked)	Map (average 3 inches) 50 head-to-tail vectors 50 nonconnecting vectors	100
Circles	Range Rings (at 5 nmi increments)	12
Circles	Other (average 4 inch diameter)	5
Map Symbols	6 of each symbol shown in Figure 3.7-10	36
Tabular Lines	Lines of 19 characters/line	2
Tabular Lines	Lines of 18 characters/line	20

*This display model is for the purpose of demonstrating display capacity and does not imply limits on the various data types.

Tables 3.2-6A,B. FDAD Display Models - Notes (cont'd)

The FDAD display models are to be demonstrated at 30 Hz on a 60 nm range scale. These additional assumptions shall be made:

1) The average distance from the origin for all data blocks and single symbols is 1/3 radius.

2) The average distance from the origin for weather vectors is 1/2 radius.

3) The average distance from the origin for map symbols is 1/3 radius.

4) A 1200 PRF shall be used.

5) It is assumed that when the FDAD is in the all digital mode, the time previously used to write analog data is now used for digital data.

Table 3.2-7. SMC Response Time

Task	Task Complete
Initial System Startup (including down loading of displays)	20 sec
System Startup (no down loading of displays)	12 sec
System Startup (power up recovery)	45 sec
On-Call Programs (Resident in main Memory)	1 sec
On-Call Programs (Resident on disk)	5 sec
Enable/Disable peripheral	1 sec
Failure of System Element (Time of failure to display on SMC)	1 sec

3.2.2 Physical Characteristics. The physical characteristics defined in the following paragraphs describe the equipment and equipment cabinets of the ARTS IIIE. These characteristics include weight and dimensional limitations, access for maintenance, health and safety criteria, equipment layout, relocation capability, installation flexibility, finish and color requirements, and data entry and display devices physical characteristics.

Throughout this specification, terms are used to refer to the physical hardware of the ARTS IIIE, including equipment, element, component, module, unit, and Lowest Replaceable Item (LRI). The term "equipment" is used interchangeably with "hardware" and means any physical part or combination of parts. The term "unit" and "element"(*) is used interchangeably to refer to any major subdivision or subsystem of the ARTS IIIE. The term "part" means one or more pieces joined together which are not normally subject to disassembly without destruction of designed use. "Component" and "part" are used interchangeably. The term "module" refers to a combination of parts mounted in or on a chassis which is removable as an entity from the cabinet in which it resides. A circuit board is considered an assembly.

* See section 6.2 definition for unit per specification FAA-6-1210 which is in consonance with ANSI Y32.16.

Tables 3.2-6A,B. FDAD Display Models - Notes (cont'd)

The FDAD display models are to be demonstrated at 30 Hz on a 60 nm range scale. These additional assumptions shall be made:

1) The average distance from the origin for all data blocks and single symbols is 1/3 radius.

2) The average distance from the origin for weather vectors is 1/2 radius.

3) The average distance from the origin for map symbols is 1/3 radius.

4) A 1200 PRF shall be used.

5) It is assumed that when the FDAD is in the all digital mode, the time previously used to write analog data is now used for digital data.

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Throughout this specification, terms are used to refer to the physical hardware of the ARTS IIIE, including equipment, element, component, module, unit, and Lowest Replaceable Item (LRI). The term "equipment" is used interchangeably with "hardware" and means any physical part or combination of parts. The term "unit" and "element"(*) is used interchangeably to refer to any major subdivision or subsystem of the ARTS IIIE. The term "part" means one or more pieces joined together which are not normally subject to disassembly without destruction of designed use. "Component" and "part" are used interchangeably. The term "module" refers to a combination of parts mounted in or on a chassis which is removable as an entity from the cabinet in which it resides. A circuit board is considered an assembly.

* See section 6.2 definition for unit per specification FAA-6-1210 which is in consonance with ANSI Y32.16.

3.2.2.1.6 Equipment Layout. All equipment shall be in accordance with the ground work space design requirements of MIL-STD-1472. Equipment layout shall provide clear and unrestricted access to any rack or equipment unit in accordance with the requirements specified in the above paragraphs. This access shall permit maintenance or removal of part or all of the equipment at any rack, unit, or console location. All equipment shall be maintainable by FAA personnel.

3.2.2.1.7 Relocation Capability. The ARTS IIIE equipment shall be capable of being removed and relocated to another building.

3.2.2.1.8 Finish and Color. The newly designed equipment shall be finished in accordance with the requirements of FAA-STD-012a. The front face and edges of exterior and interior front panels and panel doors and the exterior surfaces of console cabinets and all other exterior metallic enclosures including the doors thereof and exterior and interior trim strips shall be finished by applying one or more uniform spray coats of a baking primer which shall be fixed, applied and baked in accordance with FAA-STD-012. Such baking shall be followed by application of one or more uniform spray coats of an oven-cured coating compound, elastomeric, ultra-low glow Class A in accordance with TT-C-001558 (FAA Trans.) Color No. 30372 of Federal Standard 595. Commercial off-the-shelf equipment will be acceptable in standard manufacturers' color. Identical equipment shall have the same finish and color. The intent of these requirements is to ensure that all hardware looks the same.

3.2.2.1.9 Implosion Protection. If a direct-view CRT is used, the display shall be designed so that the high-velocity release of implosion-propelled particles is prevented. CRT fragments shall not be released into the operator's environment. All CRT fragments and all secondary fragments shall be contained by the display case, the CAT outer faceplate, and associated seals.

3.2.2.1.10 X-Ray Emission. Total display x-ray emission absorbed by operational and maintenance personnel shall not exceed the levels stated in MIL-STD-454H, Requirement 1.

3.2.2.1.11 Reserved.

3.2.2.2 SSC Physical Characteristics. The physical characteristics of the SSC equipment shall be identical to those of the ARTS IIIE as specified in paragraphs 3.2.2.1.

3.2.3 Reliability Characteristics. Reliability shall be a consideration in the planning, design, testing, and operation of the ARTS IIIE. For the operational ARTS IIIE computer, the overall reliability design goal shall be to provide continuous fail safe operation within the response times (Table 3.2-5) for the ATC services supported by these operations. If a system failure does occur, a reduced capability (3.1.1.2c) shall be provided until normal mode operation is restored. The reliability characteristics of the ARTS IIIE facility and its operating modes shall be in accordance with the ARTS IIIE availability requirements specified in paragraph 3.2.5.2.

This specification reflects the relationship existing between the reliability, maintainability, and availability characteristics and requirements of the ARTS IIIE. The availability requirements shall be considered dominant; therefore, the maintainability and reliability characteristics shall be balanced within operational constraints and system life-cycle costs to achieve the required availability. Specifically, the system shall be designed such that its hardware and software failure rates permit maintenance to be performed using the current authorized staffing levels.

3.2.3.1 Reliability Definitions. This paragraph identifies and defines the significant terms required throughout the ARTS IIIE design and development process to define the reliability and availability requirements of the ARTS IIIE. The failure definitions in this paragraph are included for the purposes of reliability and availability prediction and verification. Failures as defined for reliability/availability accounting do not necessarily imply an operational failure. The graceful degradation properties of the system are intended to permit continuing system operation in the presence of failures.

The meaning of all terms not defined herein will be in accordance with MIL-STD-721, MIL-STD-781, and MIL-STD-785B.

a. Reliability - A characteristic of the ARTS IIIE system, or part thereof, expressed as the mean time between failures under the operational conditions defined in paragraph 3.7 and the environmental conditions defined in paragraph 3.2.6.

b. Relevant Failure - A relevant failure is one that occurs due to a design or manufacturing defect, a computer program error (either software or firmware), or incorrect or incomplete technical documentation. All failures that are not specifically classified as nonrelevant, as defined below, shall be classified as relevant and shall be counted in reliability and availability requirements verifications. All failures shall be recorded, whether or not recovery procedures are invoked or maintenance is performed at that point. A relevant failure need not imply a mode or system failure (see item "e" below).

c. Nonrelevant Failure - A nonrelevant failure is one that occurs as a result of any of the following factors:

(1) Environmental stresses beyond those specified in paragraph 3.2.6.

(2) Operational stresses beyond those specified in paragraph 3.2.1.1.2 and peak aircraft bunching beyond those specified in paragraph 3.2.1.1.3.

(3) Improper or incomplete operation of equipment and facilities external to the ARTS IIIE.

(4) Improper or incomplete corrective or periodic maintenance.

(5) Negligence of operations or maintenance personnel.

d. ARTS IIIE Operational Position Failure - An ARTS IIIE operational position failure occurs whenever the display and associated input and control capabilities defined in paragraph 3.7 cannot be provided at a display within the specified response time, as a result of a failure occurring either within the display or elsewhere in the system.

e. ARTS IIIE. General - An ARTS IIIE mode failure occurs whenever a hardware or software/firmware failure interrupts the system.

3.2.3.2 Reliability Design Criteria. In order to ensure that interruptions are minimized and that system safety is maintained, the ARTS IIIE hardware shall be designed as a "failsafe" system. The following reliability-enhancing techniques shall be utilized in the ARTS IIIE design.

a. Fault Avoidance - The hardware design for the ARTS IIIE shall use standard proven parts and materials to maximum extent practicable. These parts and materials shall be selected in accordance with the parts program described in MIL-STD-785B. Latent design errors and single failure points shall be avoided through the use of highly structured specification, design, and test methodologies.

b. Fault Tolerance - The ARTS IIIE shall provide full recovery in the presence of individual or multiple hardware and software failures. The system design shall include the capability to detect these failures and shall include-fault mechanisms which establish alternative means for continued error-free system operation within the specified response time requirements.

c. Fault Containment - The ARTS IIIE shall be designed to prevent the propagation of errors resulting from individual or multiple hardware failures. The system shall be partitioned to avoid single points of failure and to minimize the effects of latent design errors on the functional capability provided to the air traffic controllers.

d. Additional design considerations.

(1) The error detection and recovery procedures shall be such that erroneous data produced directly or indirectly as a result of detected errors shall not be entered into the system data base nor leave the computer subsystem.

(2) The primary copy of the systems program instructions and constant data resident in memory shall be protected from being accidently overwritten. If normal system operation or recovery procedures require the copying of such data, all such copies shall be checked against the original by direct comparison or by other equally effective means.

(3) The system design shall permit detailed fault diagnosis, onsite repair or replacement of any of its parts, and verification of proper operation of the repaired element without degradation or disruption of the systems normal service.

(4) Recovery procedures shall be implemented such that any detected failure results in the reconfiguration of the system as necessary to achieve correct operation at full capacity. Recovery procedures shall be such as to preserve critical information which cannot be reproduced by normal system operation within the recovery time. (This shall be true even in the case of memory failures.)

(5) Failure detection shall be performed on all elements and their interfaces regardless of their state, i.e., active or backup. Where redundant components are used within a subsystem, failure detection shall be implemented for these components.

(6) The system shall allow switching of input and output interfaces to accommodate the use of redundant elements in related external systems.

(7) Notification of the failure of any element shall be available at the SMC output within 1.0 second from the time the error is detected.

(8) While recovering, for any reason, the controllers display console shall maintain the last updated alphanumeric information before initiation of the recovery. However, radar beacon analog presentations will continue to be updated.

(9) In the event of any computer failure, the controllers consoles will display beacon analog data even in the event of alphanumeric loss.

(10) The service life of the ARTS IIIE system shall be a minimum of 10 years after completion of system onsite test (SOST). All Contractor furnished hardware must contain components that can be supported for the entire life span.

3.2.4 Maintainability Characteristics. Maintainability shall be a consideration in the planning, design, testing, and operation of the ARTS IIIE. For the operational ARTS IIIE, the overall maintainability design goal shall be to provide fail safe operation, 24 hours a day, 7 days a week throughout its entire service life.

The maintainability characteristics of the ARTS IIIE's operating modes (3.1.1.2c) described shall be in accordance with the ARTS IIIE availability requirements specified in paragraph 3.2.5.2.

This specification reflects the relationship existing between the maintainability, reliability, and availability characteristics and requirements of the ARTS IIIE. The availability requirements shall be considered dominant; therefore, the reliability and maintainability characteristics shall be balanced within operational constraints and system life-cycle costs. Specifically, the system shall be designed to minimize the periods of service interruption and to ensure that ARTS IIIE maintenance can be performed using the current authorized staffing levels.

3.2.4.1 Maintainability Definitions. This paragraph identifies and defines the significant terms required throughout the ARTS IIIE design and development process to define the maintainability requirements of the ARTS IIIE. The meaning of terms not defined herein will be in accordance with MIL-STD-280E, MIL-STD-721C, and MIL-STD-470A.

a. Lowest Replaceable Item (LRI) - For restoration purposes, an LRI is considered to be an assembly, module, printed circuit board, or chassis-mounted part that is easily removed and replaced.

b. Lowest Replaceable Software Component (LRSC) - For restoration purposes, a LRSC is a subprogram software unit or collection of units.

c. Maintainability - A characteristic of the ARTS IIIE system or subsystem expressed as the probability that it will be restored to a specific condition (i.e., certification conditions have been satisfied) within a given period of time.

d. Maintenance Concept - A description of the planned general scheme for maintenance and support of hardware and software in its operational environment. FAA Order 6000.27 presents a general discussion of FAA maintenance practices.

e. Periodic Maintenance - All actions performed to retain the ARTS IIIE in acceptable operational condition including systematic

inspection and, where required, calibration. FAA Order 6000.15 presents a general discussion of FAA periodic maintenance practices.

f. Corrective Maintenance - All actions performed on failed hardware or software to restore the hardware or software to acceptable condition. These actions include automatic or manual isolation down to the defective LRI or LRSC, replacement of the defective hardware unit or software component and recertification of hardware or software operation.

3.2.4.2 Maintainability Design Criteria. The maintainability design of the ARTS IIIE shall include techniques and design features which will enable virtually all necessary maintenance actions to be transparent to the air traffic controllers. The maintainability features designed into the system shall support the overall availability requirements (3.5.1.2). The ARTS IIIE design shall include the following features/techniques:

a. Rapid and positive detection and reporting of system malfunctions, intermittent errors, or marginal performance.

b. Rapid and positive isolation of the defective LRI or LRSC to facilitate both recovery and repair.

c. Provisions for quick access, replacement, repair verification and recertification of operational status of the repaired Configuration Item (CI) and its subsystem, while the subsystem/system continues to operate.

d. Minimum maintenance skills and training needed to develop adequate maintenance proficiency.

e. Designs minimizing periodic maintenance requirements.

f. On-line maintenance capability which does not interrupt ARTS IIIE operations.

g. Scheduled maintenance (i.e., preventive maintenance) for all new equipment shall be in accordance with FAA Orders 6000.15 and 6000.27.

3.2.5 Availability Characteristics. Availability shall be consideration in the design of the ARTS IIIE. For the operational ARTS IIIE, the overall availability design goal is to provide fail safe operation within the response times for the ATC services supported by these operations on a 24 hour a day basis. Hardware and software failures are expected to occur; however, automatic fault detection, isolation, and recovery mechanisms along with judicious functional partitioning shall be utilized to provide assurance of the availability of essential functions and to minimize interruptions. If a failure in the system does occur, a reduced level of operation (3.1.1.2c) shall be provided until normal mode operation is restored.

3.2.5.1 Availability Definitions. This paragraph identifies and defines the significant availability terms that will be used throughout the ARTS IIIE design and development process. The meaning of all terms not defined herein will be according to MIL-STD-721 definitions.

a. Availability - A characteristic of the ARTS IIIE system or subsystem expressed by the probability that it will perform its required function at any instant in time.

3.2.5.2 Availability Requirements. The availability of the system in normal mode (3.1.1.2) shall not be less than 0.9975 with a Mean Time Between Failure (MTBF) of at least 200 hours. The availability of the system in the failsafe mode (3.1.1.2) shall not be less than 0.9997 with a MTBF of at least 1500 hours.

3.2.6 Environmental Characteristics. The ARTS IIIE shall meet all functional and performance requirements of this specification when subjected to the environmental conditions of this paragraph.

3.2.6.1 Equipment Operating Environmental Characteristics. The equipment shall meet all functional and performance requirements while operating under the conditions specified in Table II of FAA-G-2100e for equipment installed in attended facilities.

3.2.6.2 Equipment Nonoperating Environmental Characteristics. The equipment shall survive any combination of the conditions specified in Table II of FAA-G-2100e for storage, shipping, or transporting, and shall return to operation without degraded performance if subjected to these conditions.

3.2.6.3 Solar Radiation. ARTS IIIE equipment exposed to solar radiation in a tower cab environment shall meet all functional and performance requirements and shall retain a like-new exterior appearance.

3.3 Design and Construction. The design and construction requirements for the ARTS IIIE are as follows:

a. Continuous Operation - The ARTS IIIE equipment shall be designed and constructed so that all performance and availability requirements are satisfied throughout the minimum service life. The system shall be designed for continuous operation, 24 hours per day, 7 days a week. Each hardware element shall be removable from the system for checkout or repair purposes without degradation of specified performance and with minimal service interruption (20 sec).

b. High Maintainability - The hardware shall be physically designed and constructed to permit ready access to all modules, printed circuit boards, assemblies, parts, test points, terminals, and wiring for maintenance activity without requiring the partial or complete removal of any other module, part, or portion of the equipment. LRIs shall be installed so that they can be removed and replaced without interference from, damage to, or removal of other parts or wiring. Individual subsystem processors shall have access points to facilitate the on-line connection of testing apparatus, i.e., logic analyzers. All mechanical parts of the equipment shall be designed to require no adjustment and to be self-compensating for wear. All moving parts, including bearings used in the equipment, shall be either permanently lubricated or shall not require lubrication more often than once per year with continuous operation. All motors used in the equipment shall be designed for continuous duty operation and shall have an operating life expectancy of not less than 10 years. Software shall be designed and implemented in a manner to facilitate maintenance of the software. The design shall utilize a topdown approach resulting in a modular software architecture. The implementation of new software shall utilize modern structured programming techniques. There shall not be more than three programming languages within the system (refer to 3.3.8.3.2).

c. Operational and Technical Flexibility - The design and construction shall not restrict future redefinition of system requirements. All software and equipment, including diagnostic equipment, shall be designed to permit future system expansion if that expansion should be needed.

Except as authorized by the Government system modules and elements shall be interconnected using industry standard interfaces so that elements of differing or future design or manufacture can communicate with minimum alteration.

d. Reduced Logistic Cost - Whenever possible, common items, such as ports, modules, assemblies, enclosures, elements, and power supplies shall be used. Identical equipment types shall be used. Maintenance procedures, operational factors, supply, and performance tracking shall be the same at the ARTS IIIE and the SSC facilities. Online and offline hardware components shall be common. Additional requirements related to commonality appear in paragraph 3.3.9.

e. Minimum Development - To the maximum extent possible, standard commercial products shall be used.

f. All contractor-developed circuit cards shall be designed to interface with the FAA's Automatic Test Equipment (ATE), as specified in the statement of work, for testing and troubleshooting.

3.3.1 Materials, Processes, and Parts. All parts and materials shall meet or exceed Sections 3.4, 3.5, and 3.6 of FAA-G-2100e.

The requirements in this paragraph (and its subparagraphs) apply to all newly designed equipment.

3.3.1.1 Processes. All processes for use in manufacturing or assembling the ARTS IIIE equipment shall be selected so that their effects on life-cycle cost is minimized.

3.3.1.2 Parts. Standard proven parts and materials shall be used to the maximum extent practical. Part reliability shall be consistent with the equipment reliability.

All parts and materials used in the equipment shall be new and shall be available from multiple sources for supply during the life cycle of the equipment.

The design of the ARTS IIIE equipment shall incorporate maximum use of identical parts and components within and across equipment in order to minimize the inventory of parts.

The ARTS IIIE equipment design shall minimize use of parts requiring special tools and equipment to remove, repair, replace and adjust.

3.3.2 Electromagnetic Radiation. This section contains requirements on ARTS IIIE equipment pertaining to emissions of and susceptibility to various forms of electromagnetic radiation.

3.3.2.1 Emission. All equipment shall be electrically designed and constructed to control electric and magnetic field emissions.

All newly designed equipment and commercial off-the-shelf equipment new to the FAA inventory and without FCC certification shall be screen tested using MIL-STD-461B Part 4 for digital equipment as criteria. EMI performance characteristics will be plotted and compared to requirements in MIL-STD-461B. After review of the data by the FAA representatives, potential problems will be identified and concurred upon, and if deemed necessary by the government, a design change by the contractor will be concurred upon and implemented. MIL-STD-461B screen tests to be used are CE03 and RE02.

3.3.2.2 Susceptibility. This requirement applies to all newly designed equipment and commercial off-the-shelf equipment which is new to the FAA inventory and without FCC certification. The equipment shall be electrically designed and constructed to minimize the equipment's susceptibility to electric and magnetic fields in the operating environments. The equipment shall be screened for the conducted and radiated susceptibility requirements of MIL-STD-416B, Part 4 for digital equipment using MIL-STD-461B tests CS02, CS06, and RS03. Screening results will be reviewed by the Contractor and the FAA to identify potential problems. If deemed necessary by the government, design changes will be agreed upon and implemented by the contractor.

The equipment shall not be operationally degraded when each of its AC input leads is individually and also simultaneously subjected to a pulse of 400 volts in amplitude, 5 microseconds wide at the 50 percent points, and with a rise time of not more than 50 nanoseconds.

The equipment shall be so designed so as to minimize the equipment's susceptibility to electrostatic discharges. Because of these discharges, no system failures or service interruptions shall occur under the test conditions described below.

The equipment shall not be operationally degraded while in an operational environment when subjected to either a voltage discharge of 7KV stored in a 100 pf capacitor and discharged to the equipment case through a series impedance of 500 ohms, or to a transient current with an energy content of 2.45 millijoules.

The equipment, while in a nonoperational state, shall experience no equipment degradation or damage when subjected to a voltage discharge of 12KV stored in a 100 pf capacitor and discharged to the equipment case through a series of impedance of 100 ohms or to a transient current with an energy of 7.2 millijoules.

3.3.3 Nameplates and Product Markings. The equipment shall conform to the requirements stated in MIL-STD-454N, Requirement 67, and Sections 3.8, 3.9, and 3.10 of FAA-G-2100c.

3.3.4 Workmanship. Workmanship shall meet the requirements of MIL-STD-454H Requirement 9.

3.3.5 Interchangeability. All equipment and parts, including maintenance and test equipment supplied by the contractor, that are interchangeable or replaceable shall conform to Requirement 7 of MIL-STD-454H.

3.3.6 Safety Requirements. The following sections provide requirements for ARTS IIIE equipment design to ensure personnel, equipment, and environmental safety.

3.3.6.1 Personnel Safety. The equipment design criteria shall be in accordance with Requirement 1 of MIL-STD-454H, Sections 3.3.1.7 and 3.3.1.8 of FAA-G-2100e, and the following additional requirements:

a. Microwave and X-Radiation Safety - Minimum safe distance from equipment for personnel with pacemakers shall be clearly defined.

b. Radioactive Material Safety - Optical products shall contain no thorium or other source materials as defined by Title 10, Code of Federal Regulations (CFR), Part 40, in excess of 0.05 percent by weight (500 ppm) or any other added radioactive materials. Optical products are defined as optical glass constituents or raw materials; optical glass components such as windows, filters, reflectors, prisms, beam splitters, lens elements, and fiber optics; optical assemblies; and optical coatings except for infrared (IR) objective lenses.

Radioactive material is defined as radioactive material per item in excess of the concentrations listed in Schedule A, Title 10, CFR, Part 30, or in quantities greater than 0.001 microcurie.

3.3.6.2 Equipment Safety. The ARTS IIIE shall be designed to minimize equipment damage, degradation of efficiency, and mission failure due to operator-induced errors, improper cabling, power failure or electrical overstress on components during installation, storage, operation, handling, maintenance, and transportation.

Specific design techniques for equipment protection shall include the following:

a. Electrical overload protection shall be in accordance with requirement 8 of MIL-STD-454H.

b. Contacts used on chassis, panels, or cable entrance connectors shall be recessed to prevent breakage or damage.

c. Positive means shall be provided to prevent the inadvertent reversing or mismating of fittings, couplings, mechanical linkage, instrument leads, or electrical connections.

3.3.6.3 Environmental Safety. The ARTS IIIE shall be designed to provide an acoustical environment that will not cause personal injury or fatigue or in any other way degrade overall system effectiveness.

Noise level limits for newly developed equipment shall conform to those in paragraph 3.1.1.7 of FAA-G-2100e. Steady state and impulse noise caused by the equipment shall not exceed noise criteria as specified in MIL-STD-1474B(MI). The fact that a component that contributes to the overall noise may be GFP shall not eliminate the requirements set forth in MIL-STD-1474B(MI).

This requirement shall not be interpreted so as to cause replacement, refurbishment or reconfiguration of GFP currently existing at the ARTS IIIE sites or FAATC. With respect to commercial off-the-shelf (COTS) equipment (including additional quantities of equipment currently existing at the sites or FAATC) waivers to the requirements of MIL-STD-1474B will be considered on an individual basis.

3.3.7 Human Engineering. The ARTS IIIE shall be developed in accordance with a human engineering program consisting of human engineering analysis, design, and test efforts.

3.3.7.1 Analyses. These analyses shall include at least the analyses of critical human tasks associated with operating and maintaining the ARTS IIIE.

3.3.7.2 Physical Factors. The ARTS IIIE shall be designed so that human factors design standards and requirements of this specification, MIL-STD-1472C and MIL-B-46855 are met.

3.3.7.2.1 Noise Limit. The ambient noise level at all positions shall not exceed the limits specified in FAA-G-2100e when measured at the level of the head of a person in their normal operating position. For purposes of this paragraph, ambient noise is the total of ARTS IIIE and all non ARTS IIIE noise.

3.3.8 Software. This section provides requirements for the attributes of the ARTS IIIE software and the characteristics of the software design and development techniques. At a minimum, ARTS IIIE software design, development, and documentation shall be conducted in compliance with the requirements of DOD-STD-2167A, Defense System Software Development. The primary objectives of these requirements are to ensure correctness, reliability, efficiency, and maintainability of the software and to adequately plan and execute the software development process. The following paragraphs contain requirements for software development planning, and software design.

3.3.8.1 Development Planning. All software shall be designed and implemented according to an FAA-approved Software Development Plan.

3.3.8.2 Software Design. All ARTS IIIE software shall be designed in accordance with design standards found in DOD-STD-2167A. In addition to the functional and performance characteristics described in other paragraphs of this specification, the software design shall accommodate the following requirements:

a. Design emphasis shall be placed on reliability, error detection, fault analysis, fault tolerance, and recovery from abnormal conditions.

b. The design shall support system modification, enhancement, and expansion throughout the expected lifetime of the ARTS IIIE. Provision shall be made in instruction code, data tables, and data base to accommodate additional functions, new equipment, and new data.

c. The software design shall provide application program and data base independence. Changes made to the data base elements shall not impact the program instructions or vice versa.

d. The software design shall provide data integrity. The software shall be in accordance with FAA Order 1600.54, and the following factors shall be considered:

(1) Operating System Integrity

(2) Data Base Integrity

(3) House Keeping

(4) Audit Trails, Trace Routines and other debug tools.

e. The software design shall provide a common and controlled approach to adding new data and to modifying and retrieving existing data. It shall provide logical data to the application programs as required. It shall provide status information to the application programs on the outcome of data requests including error indications.

f. The software design shall assure that a failed subsystem is initialized to a correct, well defined state upon recovery (3.1.1.2.c).

g. The software design shall ensure that all displayed data at the time of fault will continue to be refreshed until subsystem reinitialization.

3.3.8.2.1 Architecture. The ARTS IIIE software specifications shall be translated into a top-level design or software architecture. The architecture shall minimize the complexity of interfaces between software units and keep unrelated functions separated.

3.3.8.2.2 Unit Attributes. The software design shall be functionally and operationally modular to:

a. Facilitate system expansion, modification, and configuration control.

b. Enhance system reliability by facilitating fault detection, diagnosis, containment, recovery, and fault-tolerant behavior.

c. Facilitate data base changes to the lowest practical level without large program reassemblies.

Each unit shall perform a unique function, with inputs, outputs, and interunit interfaces clearly defined. Each unit shall be compiled separately.

Each unit shall consist of a specification part, data declarations, and flow charts. The specification part shall contain the information necessary to use the unit without describing the internal details of how the unit operates. The data declarations shall define the logical entities needed by the unit and the flow charts shall define the operations to be performed. Only statements within a unit shall access private data of that unit. Other units shall access data through interfaces provided by the unit.

3.3.8.2.3 Design Representation. The design shall be represented in a manner which facilitates traceability to the specification, ease of understanding, and ease of design implementation. The representation shall be maintained as part of the design data base.

The ARTS IIIE design representation shall:

a. Provide a natural expression of the control constraints specified for code development.

b. Be compatible with the properties and facilities of the language candidate and its automated tool implementations.

c. Facilitate a precise specification of the design and impose a rigorous structure on the design.

d. Be directly processable by the tools specified in 3.3.8.2.4, below, to facilitate the analysis provisions noted and to enable automated standards enforcement to be accomplished.

e. Be comprised of successive, independent level of abstraction with an independent set of objects and the operations on these objects defined at each level.

f. Explicitly document design decisions with high-order decisions not affected by low level implementation.

g. Be expressed in such a way that programmers receive only that information needed to complete a unit and users receive only that information needed to use a unit.

h. Provide formal, testable unit specifications with design decisions decoupled and encapsulated, interfaces explicitly defined, and complete documentation of dependencies.

i. Promote data integrity by allowing only valid operations on data.

j. Allow only functional interfaces to be shared by users and providers.

3.3.8.2.4 Special Tools and Techniques. Automated design support tools shall be used to record, analyze, and maintain the ARTS IIIE software design and data base management. These tools shall provide:

a. Traceability of software system components to software requirements.

b. Configuration control and tracking of changes in the design and software requirements.

c. Completeness and consistency testing of all software units.

d. Modeling and simulation to support processing resource allocation and to predict system performance under varying workloads.

e. The means to verify adherence of the design to software design standards.

f. The means to indicate in the design representation that a design feature is incomplete and to later identify and track all such incomplete design features.

g. Various printed outputs such as source listings, error lists, cross-reference lists, flow charts, hierarchy charts, and design change history logs.

The tools shall be applicable throughout the software development and maintenance Life cycle. They shall address all aspects of operational software design including algorithms, data structures and files, and interfaces.

All tools, techniques, software and documentation used by or developed by a contractor to implement this specification and required to support the design, development, implementation, test or maintenance of the ARTS IIIE system, shall be delivered to the Government complete with documentation which fully describes its purpose and execution.

3.3.8.3 Software Implementation. All ARTS IIIE software shall be implemented in accordance with DOD-STD-2167A. These standards shall include the use of a single language for all software executed in contractor furnished microprocessors, modern structured programming techniques, unit and variable naming conventions, readability, and the use of descriptive comments.

All software shall conform functionally and structurally to the software design.

All software shall be documented according to software standards specified herein. All off-the-shelf software shall meet the documentation standards. Any waiver from the above requirements shall be justified by the contractor and submitted to the FAA for approval. All units shall be implemented with one entry and one exit with the exception of error conditions.

3.3.8.3.1 Unit Attributes. All units shall have the following attributes:

a. A program unit shall contain the code required to implement a single, well-defined function.

b. High-Order Language (HOL) source code shall be indented to clearly denote logical levels of constructs.

c. All source code segments shall have sufficient annotation, i.e., comments, to explain inputs, outputs, branches, and other items not obvious in the code itself. Explanatory notes shall be uniformly indented.

d. Except for comment statements, non-executing statements shall be grouped in one area in each unit to simplify debugging and maintenance.

e. Data declarations shall be grouped and arranged in a meaningful order in the code, e.g., columnar rather than a horizontal string.

f. Data names and procedure labels shall be meaningful.

g. Each line of source code shall contain one statement only.

h. Formats for error and diagnostic messages shall be standardized.

i. Loop indexes shall not be altered during loop execution.

j. Unnecessary assignment of a constant value to a variable (especially within a loop) shall not be made.

k. Code shall be written so that no code after initialization can be automatically modified during execution.

l. Units shall not share temporary storage locations of variables.

m. Each unit shall be uniquely identified.

n. Complicated expressions, such as compounded negative Boolean expressions, and nesting beyond three levels shall not be used.

o. Mixed mode numerical expressions shall not be used.

3.3.8.3.2 Code Representation. No more than three program languages, only one of which may be a high order language (HOL), shall be used for all code in the ARTS IIIE. Three languages may only be used when one is a HOL and it is necessary for reasons of efficiency or where more closely controlled manipulation of registers and data is required which cannot be achieved using the HOL. This third language must be the assembly language for the target processor on which the compiled HOL code executes. If the ARTS III Ultra language is not used only two languages shall be used; a HOL and the machine assembly language of the target processor as limited above.

The above applies to developmental code (including operational, training and support). It does not apply to vendor-furnished code.

3.3.8.3.3 Special Tools and Techniques. Automated tools shall be used to support the software development process. These tools shall provide or facilitate the use of:

a. Software configuration management

b. Common datatype definitions and procedure libraries

c. Cross-reference listings and indices

d. Reformatted program source text to provide a uniform and consistent style

e. Measurement of program size and complexity

f. Unit interface checking and identification of other program anomalies

g. Unit testing and debugging facilities, including data recording and reduction

h. Compilation, linking, and loading

i. Data management

j. Verification of adherence to software programming standards.

All tools, techniques, software and documentation used by or developed by a contractor to implement this specification and required to support the design, development, implementation, test or maintenance of the ARTS IIIE system shall be delivered to the Government complete with documentation which fully describes its purpose and execution.

3.3.9 Commonality. The ARTS IIIE design shall maximize the use of common software modules and physically and electrically identical units, assemblies, and subassemblies, consistent with minimization of overall life-cycle costs.

3.3.9.1 Local Networking. Should a Local Area Network (LAN) be used to interface the ARTS IIIE subsystems it shall meet the following requirements to allow equipment of differing design or manufacturer to communicate, to support the phased introduction of new or additional ARTS IIIE sub systems and interfaces to other systems, to allow for ease of reconfiguration, to reduce duplication of resources and to provide for smoother growth. The LAN shall include all hardware and software necessary to meet the requirements of this specification.

The local area network shall be designed and constructed to meet the following requirements:

a. The network as a whole shall be more reliable than the attached ARTS IIIE equipment or the individual network access devices.

b. No single failure within the network shall cause network failure.

c. The network access devices shall be more reliable than the various computer, or other ARTS IIIE equipment that attach to them.

d. Network components or interface circuitry shall be allowed to be added, moved, or deleted without requiring system checkout for unchanged interfaces.

e. Network data transmission shall continue on an uninterrupted basis unaffected by the repair or replacement of various computers, or other ARTS IIIE equipment or other systems that connect to the network.

f. The network shall be compatible with the overall system RMA including the functional response time requirements.

g. The network shall not corrupt data passing through the network and shall provide error detection/error correction measures.

h. The network shall include features which facilitate network maintenance, diagnostics, and services.

i. Network error status shall be passed to the system monitor console.

j. The network shall comply with the IEEE 802 Local Network Standards.

k. Communications within the local area network and through other connected networks shall comply with the International Standards Organization (ISO) Open Systems Interconnect (OSI) Reference Model and ISO communication protocol standards.

l. Any material used in the local network shall be nonproprietary, or shall be available to the Government.

m. The network shall be designed to use standard and commercially available, multiple sources, component parts.

n. The network shall allow addition or replacement of compatible equipment regardless of the equipment manufacturer.

o. The network shall provide both a fair access scheme and a prioritized access scheme. If an IEEE 802.3 LAN is used, the CSMA/CD and backoff algorithm specified by IEEE 802.3 shall be used in lieu of a fair and prioritized access scheme.

p. The network shall minimize constraints on changes to the topology of the network and the transmission medium used for the network.

3.3.10 Equipment Classification. The IIIE system equipment shall be classified into three categories as specified below. Qualification of equipment shall conform to the methods specified below. The qualification requirements below are not intended to specify or constrain any normal invoice/payment process of the contract or statement of work.

3.3.10.1 Category I - Mission-Critical Equipment. Mission-critical equipment shall include any device directly connected to the LAN and any device critical to maintaining the ATC automation functionality provided to the controller. Qualification of mission-critical equipment shall be tailored by the equipment's further classification into subcategories of: (1) Standard ARTS IIIA/IIIE equipment, (2) Off-the-shelf equipment or (3) Newly designed equipment.

(1) Standard ARTS IIIA/IIIE equipment shall be produced in accordance with existing engineering documentation and tested in accordance with the product specifications and procedures previously used for its production.

(2) Off-the-shelf (OTS) equipment shall be compliant with the operational temperature and humidity requirements specified in FAA-G-2100e. Test data shall be supplied to verify its compliance but full type testing is not required. The equipment shall also comply with the noise, electrostatic discharge, and EMI screening requirements of this document, paragraphs 3.3.2.1 and 3.3.2.2. The OTS equipment shall comply with FAA-G-2100e sections (and subparagraphs of) 3.3.2.3 and 3.3.4 for power requirements. Analysis may be used for verification if the government concurs. The OTS equipment shall be subject to all system-level requirements for MTBF and MTTR. A safety analysis checklist shall be developed and provided to the government for analysis at the hardware Critical Design Review (CDR). The government will consider waivers when the above requirements cannot be met with OTS equipment but the intent of the government is to ensure that all mission-critical equipment be of comparable quality to equipment built to conform to FAA-G-2100e.

(3) Newly designed equipment shall meet all the applicable requirements of this specification and FAA-G-2100e.

3.3.10.2 Category II - Mission-Support Equipment. Mission-Support Equipment shall include equipment which is not directly connected to the LAN and, if failed, would not affect the ATC automation functionality provided to the controller. This equipment may, however, still be necessary to provide all the functionality of the system and, therefore, may be subject to MTBF and MTTR requirements. This equipment shall be selected using the criteria of 3.3.10.1-(2) as a guide. Data on the equipment characteristic versus the requirements of paragraph 3.3.10.1-(2) shall be presented at hardware CDR. Qualification of this equipment, once accepted by the government at CDR, shall be by the contractor's normal procedure for this equipment. Government acceptance shall be at its proper operation during formal system testing.

3.3.10.3 Category III - Off-Line/Support Equipment. ARTS IIIE off-line/support equipment shall include equipment not normally active during live ATC operations. This includes software development stations and test support equipment. This equipment shall be selected to operate reliably in the appropriate environment and shall be presented at PDR with its general characteristics. Qualification of this equipment shall be in accordance with the contractor's normal procedures for this type of equipment. Government acceptance shall be at its proper operation during formal system test.

3.4 Documentation.

The documentation, as defined below shall be utilized in the development, implementation, test, installation, operational use, and maintenance of the hardware, software, and firmware configuration items of the ARTS IIIE and will provide the basis for the review and verification that the system satisfies the intent of the procurement. Commercial manuals may be used for commercial off-the-shelf equipment to the extent they meet the content requirements of the procurement. They need not meet format requirements.

3.4.1 Specifications. The documents specified in this section are required in order to provide an orderly means of defining the requirements and intentions of the design of the overall system and its associated subsystems, provide a vehicle to verify the upward and downward traceability of requirements between the various levels of documentation, and provide a means to verify that the operational and maintenance requirements of the overall system will be met.

3.4.1.1 System Requirement Specifications. All system requirements shall be documented in the system requirement specifications. The system requirement specifications shall state the technical and mission requirements of the

system as a whole, allocate those requirements among the various subsystems, and define the interfaces between subsystems, and between the ARTS IIIE and any other systems with which the ARTS IIIE system interacts. The specifications are maintained current during the ARTS IIIE procurement phases. The system requirement specifications enable the government to assess whether or not all of the requirements have been met.

3.4.1.2 Development Specifications. The ARTS IIIE design shall be documented in development specifications. A development specification states the requirements for the design or engineering development of a Configuration Item (CI) or Computer Software Configuration Item (CSCI) during the development phase. The choice of CIs and CSCIs shall be governed by the criteria provided in MIL-STD-483, paragraph 170. The Government explicitly retains its right to designate the CIs and CSCIs (DOD-STD-480, paragraph 110.18). Each development specification contains detail sufficient to describe effectively the performance requirements that each CI or CSCI is to achieve, along with the intent of the design of that CI or CSCI. These specifications shall be prepared for all system/segments, hardware, and software, and the associated data bases required by the ARTS IIIE. Software development specifications include Software Requirements Specifications and Interface Requirements Specifications. Individually and together, development specifications will provide the basis for the review and verification that CIs and CSCIs meet the system requirements.

3.4.1.3 Product Specification. All ARTS IIIE products shall be documented in product specifications. Product specifications are and may be oriented either toward procurement of a product through specification of primary function and performance requirements, or the primary fabrication (detailed design) requirements.

A product function specification states the complete performance requirements of the product for the intended use, and necessary interface and interchangeability characteristics; it covers form, fit, and function. A product fabrication specification shall be prepared when both development and fabrication of the item are procured. These specifications will contain specific references to the appropriate development specification, a detailed description of the parts and assemblies of the product, and those performance requirements, tests, and inspections necessary to assure proper fabrication, adjustment, and assembly techniques. Software product specifications include Software Top Level Design Documents, Software Detailed Design Documents, Data Base Design Documents, and Interface Design Documents.

3.4.2 Interface Control Documents (ICDs). All ARTS IIIE interfaces shall be documented in ICDs. The existing ICDs or those developed on other FAA programs may be incorporated by reference. The ICDs shall specify the interfaces between the ARTS IIIE and all interfacing systems to assure complete compatibility between these systems.

The requirements describing the physical interfaces shall be specified in quantitative terms, e.g., input/output voltages, and shall include, either directly or by reference, interface control drawings, and other engineering data as necessary to assure intra- and intersystem compatibility as well as compatibility with the system specifications.

3.4.3 Test Documentation. All aspects of ARTS IIIE testing shall be documented. Test documentation shall include test plans, test specifications, test procedures, and test reports, for both system and subsystem testing.

3.4.3.1 Reserved.

3.4.3.2 Test Plans. Test plans shall define the scope of testing required to insure that the system, subsystem, CIs, CSCIs, CSCs and hardware and software units meet applicable requirements as contained in, or derived and allocated from, the system specification. Test plans shall discuss the test configurations and test environments, identify the test facility, equipment, and simulation program requirements, test methods employed to measure performance and the data reduction and analysis requirements, and provide a schedule for conducting the tests. The plans shall also identify the corresponding test descriptions, procedures, and reports to be provided.

3.4.3.3 Test Descriptions. Test descriptions shall identify the physical, functional, or performance characteristics to be tested. For individual test cases, the descriptions shall identify the required inputs, the outputs that must be recorded, the expected results and the success criteria to be applied to those results.

3.4.3.4 Test Procedures. Test procedures shall provide procedures and instructions for preparation, execution, and documentation of tests. Test procedures shall also include expected results, pass/fail criteria, and instructions for any required data reduction and analysis of test results.

3.4.3.5 Test Reports. Test Reports shall document the results of tests. They shall contain expected and measured results and intermediate calculations or data needed to obtain the measured result from observed data. Test reports shall also contain a detailed explanation of any discrepancies.

3.4.4 Quality Assurance Plans. The quality assurance program, implemented to assure compliance with all requirements of the ARTS IIIE contract, shall be documented in quality assurance plans in accordance with FAA-STD-016 and FAA-STD-018.

3.4.5 Logistic Support Plans. Maintenance aspects of the ARTS IIIE shall be documented in logistic support plans. The plans shall document the most cost-effective maintenance approach for each LRI, software unit and firmware component. They shall also address the development and acquisition of support equipment, provisioning, training and other elements of logistics. These plans shall be developed in accordance with the articles of the contract.

3.4.6 Software Development Plan. All aspects of ARTS IIIE software development shall be documented in the software development plan. This plan shall describe the schedule, organization, resource allocation, software design and programming standards, tools and techniques, the content of each build at each stage of software integration, and testing approach for each build planned by the contractor. This plan shall be developed in accordance with the articles of the contract.

3.4.7 RMA Program Plan. All aspects of the ARTS IIIE reliability, maintainability, and availability program shall be documented in the RMA program plan. This plan shall address the tasks to be performed to insure that the ARTS IIIE design meets RMA requirements, including the trade-offs made in the design, the approach taken in demonstrating ARTS IIIE compliance with RMA requirements, and how RMA related problems will be resolved. This plan shall be developed in accordance with the articles of the contract.

3.4.8 Configuration Management Plan. The responsibilities and procedures for implementing the requirements of configuration management plans shall be documented in the configuration management plans. The plan shall address change control procedures, status accounting, configuration identification, program support libraries, development test facility configuration and usage, and forms and instructions in support of configuration management. These plans shall be developed in accordance with the articles of the contract.

3.4.9 Manuals. Manuals are the documentation that describe how to install, use, and maintain the ARTS IIIE system and are addressed to all levels of users of that system. As such, they are written to reflect the capabilities and status of a specific version of the system and are maintained as such.

3.4.9.1 Installation Manuals. All installation aspects of the ARTS IIIE shall be documented in installation manuals in accordance with FAA-D-2494/1. The installation manual is intended primarily for personnel responsible for the installation of the various equipment associated with the ARTS IIIE. As such, it shall present detailed step-by-step instructions for installing and testing the system on site. It shall begin with detailed instructions on conducting a site survey to determine the readiness of the facility to accept the system, present in detail the sequence of unpacking, setting up, cabling, applying power, and testing the various equipments. It shall detail the timing and sequence of all necessary procedures for conducting installation tests. This manual shall be closely associated with, and make significant use of, the manuals provided with the equipment being installed.

3.4.9.2 User Manuals. All aspects of the ARTS IIIE of importance to the users shall be documented in user manuals. User manuals are the documentation that describe specific operating procedures to be used by the various levels of users of the ARTS IIIE system in the performance of their duties. The level of users to be addressed by these manuals are: the computer operator, the software maintenance programmer, the controller, the supervisor, and senior staff.

The Computer System Operator's Manual shall provide instructions for keeping the delivered program operating as designed and installed. It shall contain instructions for the interpretation of any system error indications, and the proper corrective action to be taken for each indication. As such, it shall also include instructions for the use of all maintenance or diagnostic programs that are delivered with the system.

The Software Programmer's Manual and Firmware Support Manual are intended to present the programmer charged with maintaining the delivered program with a set of efficient procedures for fault discovery and application of appropriate remedies. It shall include instructions on the use of debugging and software test hooks in the delivered program, the preparation of test material and the level of integration required to remedy software faults in a variety of maintenance situations. It shall include instructions for the use of all software maintenance or fault diagnostic programs that are delivered with the system.

The controller manual is intended to be the sole reference for individual controller training and position operation. As such, it shall contain sufficient detail such that no other user document is necessary for training or operating that position. Every control button, switch, readout, or display affected by the operational program shall be covered completely at the level of detail required by the controller. Illustrations of the equipment are included to aid the controller in locating controls. However, operating instructions for equipment whose function is satisfied purely by turn on/off procedures, and that are affected only by software action, that is not controller initiated, shall not be included.

The supervisor manual is intended to provide supervisors and other senior staff personnel with a basic, non-technically oriented description of the ARTS IIIE system's capabilities, and its place in the overall ATC system. This manual shall cover all features of the system as viewed from its users, in broad terms of capability, as prescribed by the system requirements document from which, among other documents, it was derived. However, the system functions are described only insofar as they convey an understanding of that function's capability in its operational environment.

3.4.9.3 Maintenance Manuals. All ARTS IIIE maintenance aspects shall be documented in maintenance manuals. These manuals shall be designed to support those personnel responsible for the day-to-day maintenance of the equipment associated with the ARTS IIIE. The maintenance manuals shall be prepared on a CI basis. Upon detection of a failure, a step-by-step procedure shall be provided that will direct the user from the symptom of the failure to its cause, and then provide detailed instructions for the repair action to be performed once the problem has been determined. The maintenance manuals shall also include a Replaceable Parts List to assist the user in identifying failed items so that replacement can be accomplished. Detailed instructions and procedures for equipment calibration shall also be provided for those CIs requiring such service. Periodic maintenance procedures shall also be identified.

The ARTS IIIE shall be documented when delivered. This documentation shall detail the exact contents of each CSCI delivery, and is also the vehicle by which the physical delivery of the CSCI is accomplished. It shall relate the CSCI and its contents to the CM records for that CSCI and provide traceability back to all pertinent specifications. It shall also provide detailed information on each delivered CI.

3.4.10 Software Delivery Documentation.

3.4.10.1 Version Description Document. A version description document shall be prepared to accompany the release of each version of a CSCI. It shall identify the items delivered and record any additional pertinent data relating to the status and usage of the CSCI. All information as to the content of the CSCI shall be related to the applicable specifications and configuration management records pertaining to that CSCI. It shall contain, as a minimum, the complete CSCI/version identification, an inventory of the delivered material, as inventory of the CSCI contents, all Engineering Changes (ECs) that have been installed since the last release, the required site adaptation data/changes required, interface compatibility changes to other CIs/CSCIs required by the installed ECs, a bibliography of reference documents, an operational description of all newly installed ECs, and installation instructions.

3.4.10.2 Program Package Document. The program package document is the vehicle used for the actual physical delivery of the CSCI. It shall contain the source and object code for the CSCI in machine-readable form, a complete set of compile/assembly listings, and any other necessary data/information/programs necessary for the proper installation and maintenance of the CSCI. All material/documentation contained in the delivery shall be cross-referenced to the version description document.

3.4.11 Hardware Delivery Documentation. These documents shall provide detailed as delivered mechanical and electrical information on each CI and associated subassemblies.

3.5 Logistics.

This section sets forth the system requirements for hardware and software maintenance, logistics support, and the facilities and facility equipment impacted by the ARTS IIIE. In addition to specification details, background and other explanatory information is provided to aid in understanding maintenance concept changes that are currently being implemented by the FAA.

An Integrated Logistics Support (ILS) approach shall be used to evaluate the impact of design alternatives on the cost of ownership; determine a cost-effective maintenance plan for equipment parts, printed circuit board/modules/assemblies which, when failure occurs, can be removed and

replaced to restore the system to operation; determine a cost-effective maintenance plan for software and firmware; and guide the elements of logistics in planning, developing, and implementing the support system.

The ARTS IIIE design and integrated logistics support approach shall also address:

a. Insuring that overall mission needs are met and the total overall cost of ownership is minimized.

b. Providing more efficient maintenance service despite budget and personnel position ceilings.

c. Improving software maintenance through the use of modern software maintenance concepts.

d. Training.

3.5.1 Maintenance

3.5.1.1 Hardware Maintenance Requirements and Analysis. The hardware maintenance requirements of the design shall be augmented with maintenance features which make support compatible with the maintenance concept. These maintenance features shall reduce repair time by providing the technician with the ability to diagnose a malfunction rapidly, identify the failed unit, and replace it quickly. The maintenance features that shall be considered for use include: internal on-line diagnostics to identify the failed unit; simple removal and replacement maintenance methods to restore the equipment to an operable condition; built-in test equipment to aid in fault isolation where necessary.

Support analyses of the equipment maintenance requirements shall be performed at the lowest replaceable item level to determine the most cost effective logistics support plan. Parts replacement may be appropriate or, for printed circuit boards, modules, assemblies, for example, the Logistics Support Analysis (LSA) may recommend repair on site, at a central repair facility, the FAA Depot, or discard. All maintenance support plans shall be structured to maintain the system availability. Integrated Logistics Support (ILS) planning shall be accomplished in concert with the design to guide or constrain design as necessary, and to guide the planning, development, and implementation of the logistic elements of support (manuals, spare/repair items, support equipment (tools and test equipment) and provisioning technical documentation). The analyses and plans shall also address the design, development, and production of hardware and firmware modifications required to improve system performance, add new system functions, and expand system capabilities.

3.5.1.1.1 Maintenance Concept. Maintenance of the ARTS IIIE shall comply with the maintenance philosophy and projected concept described in FAA Order 6000.27. Maintenance shall be performed by a relatively small, multi-skilled technical work force. Routine periodic maintenance shall be minimized.

3.5.1.1.2 Hardware Maintenance. Hardware maintenance shall consist of two types, corrective maintenance (CM) and periodic maintenance (PM), and shall apply to the system and subsystem equipment.

3.5.1.1.2.1 Periodic Maintenance. Periodic maintenance is defined as all actions performed to retain the ARTS IIIE in acceptable operational condition, including systematic inspection and, where required, calibration. As part of the maintenance planning, periodic maintenance schedules shall be developed to check or recondition the ARTS IIIE to prevent or reduce the probability of a failure or degradation in subsequent service. Periodic maintenance activities

shall not interfere with normal FAA facility operations. The system/equipment design shall minimize the frequency and duration of periodic maintenance tasks. The resultant system characteristics shall minimize periodic maintenance tasks and minimize the numbers of facility/equipment site visits. Periodic maintenance tasks and periodicity shall be flexible enough to allow for periodic maintenance to be accomplished in conjunction with corrective maintenance tasks. FAA Order 6000.15 presents a general discussion of FAA periodic maintenance practices.

3.5.1.1.2.2 Corrective Maintenance. Corrective maintenance is defined as all actions performed to locate and replace a failed LRI to an operational state. As part of maintenance planning, trouble/cause tables shall be included in documentation used by maintenance technicians performing corrective maintenance procedures. Corrective maintenance is initiated following notification that equipment is inoperative (off line) or that degradation of function has occurred or it has been determined that failure is imminent. The equipment shall be designed for ease of equipment/system maintenance by removal and replacement of a faulty LRI with a serviceable spare. The LRI is a designated field replaceable item.

3.5.1.1.3 Maintenance Levels. Maintaining availability of FAA facilities is the prime functional responsibility of FAA field maintenance personnel. The system design for maintenance shall be predicated on the following levels of maintenance activity for maximum responsiveness, productivity, and efficiency in utilization of maintenance personnel resources. The levels consist of (1) Onsite Maintenance, (2) Support Maintenance, and (3) Depot Maintenance.

3.5.1.1.3.1 Onsite Maintenance. The FAA onsite maintenance constitutes periodic maintenance and repair actions as required to maintain the ARTS IIIE in fully operational status. Onsite maintenance shall be conducted in accordance with policy and guidance set forth in FAA Order 6000.27. Onsite maintenance shall also include non-routine repair actions requiring system analysis of faults, troubleshooting, and testing in accordance with equipment manuals, logic diagrams, or manufacturer's handbooks to identify faulty components, units, or assemblies and to effect repair.

3.5.1.1.3.1.1 Onsite Maintenance Responsibility. Direct onsite maintenance shall be the responsibility of and shall be performed by technical personnel located at the ARTS IIIE equipment. This maintenance shall consist of periodic checks of equipment, monitoring performance, inspecting, cleaning, servicing, adjusting, diagnosing and isolating system/equipment faults to a failed LRI, removing and replacing the LRI, and checking out the system/equipment to certify its usability.

Certification shall demonstrate that a system, subsystem, or equipment is providing the required or specified services to the user. The ARTS IIIE shall be designed to support certification at unit, subsystem, and system levels. Certification programs shall be designed to operate online and these programs shall not interfere with the operational use of the system.

3.5.1.1.3.1.2 Repair of Failed LRIs. Where repairable LRIs are replaced and cannot be repaired onsite, they are forwarded to the appropriate maintenance repair level in accordance with 3.5.1.1.3.2 and 3.5.1.1.3.3. Central maintenance has the responsibility for LRI repairs which require specialized equipment.

3.5.1.1.3.1.2 Support Maintenance. Support maintenance shall be provided in support of sector personnel in solving difficult problems or problems which are nationwide.

3.5.1.1.3.1.3 Depot Maintenance. FAA depot maintenance is provided for maintenance of equipment which are not feasible or cost effective to repair or overhaul on site.

3.5.1.1.4 Maintenance Activities. The support analysis and maintenance planning shall consider the maintenance activities described in the following sections for performance of LRI/Equipment/System Maintenance. The analysis and planning shall address the cost effectiveness of the various maintenance concepts for assemblies once removed from operation.

3.5.1.1.4.1 Onsite Maintenance. Technical personnel assigned maintenance responsibility for the ARTS IIIE are to perform corrective and periodic maintenance. This includes use of terminals as troubleshooting aids, conducting physical inspections, calibrating, verifying and certifying the operating equipment and monitoring devices, conducting plant maintenance and repairing monitoring equipment which is considered part of the facility.

3.5.1.1.4.2 Support Maintenance. Support Maintenance is provided by support groups located at the FAA Technical Center (3.5.1.1.4.4).

3.5.1.1.4.3 Depot Repair. Equipments of a complex nature or modules, requiring very specialized repair procedures or equipment, as identified via support analysis and maintenance plans, shall be designated for repair at the Depot. The Depot repair may be accomplished at the FAA Depot or a vendor facility, whichever is cost-effective.

3.5.1.1.4.4 National Field Support. The support groups, located at the FAATC, will provide skills necessary to analyze and correct system wide or national problems, as well as assist sector support staffs in diagnosing difficult site problems. This support will include correction of facility-type problems and development and control of software and equipment modifications.

3.5.1.1.5 Maintenance Facilities. The maintenance facilities are categorized as (a) onsite, and (b) Depot. The support analysis and maintenance plans shall be used to establish the most cost-effective level of repair for unique LRIs.

3.5.1.1.5.1 Onsite Facility. The ARTS IIIE shall be designated for maintenance planning as an onsite facility. These facilities are manned by maintenance technicians. The site shall be the reporting point and duty station from which maintenance technicians begin routine or restoration maintenance.

3.5.1.1.5.2 FAA Depot. The Depot maintenance facilities shall provide support for repair, alignment, and calibration of complex equipment and modules requiring specialized equipment and procedures. This facility provides the maintenance capability for completely overhauling and rebuilding equipment as well as the performance of highly complex maintenance actions which are beyond the resources of the field maintenance organization. The Depot also serves as the major logistics support facility for field accomplishment of onsite maintenance activities.

The Depot is an FAA facility which at its option may return certain specialized items to a vendor facility when more cost-effective.

3.5.1.1.5.3 Standard Test and Repair Equipment. For each maintenance facility standard test and repair equipment necessary to test and repair each equipment/system shall be identified. The equipment shall be adequately described for easy identification and procurement and shall include the manufacturer and model number. Standard catalog test equipment shall not be modified without prior FAA approval.

3.5.1.1.5.4 Special Test and Repair Equipment. For each maintenance facility, all special test repair equipment (including printed circuit board and module fixtures and any test software which is necessary for use of the test equipment) required for maintenance of system equipment shall be identified.

Special test equipment shall be used only if standard catalog test equipment to perform the test function is unavailable from any manufacturer. In addition to special test equipment, any special repair equipment required to repair system assemblies, subassemblies, modules, and, where applicable, components shall be identified.

3.5.1.1.5.5 Maintenance Tools. For each maintenance facility, all tools, common and special, required for maintenance and repair shall be identified. Common tools shall be adequately described for easy identification and procurement. Special tools are defined as tools required for maintenance of each system and not available as a standard catalog item from the General Services Administration (GSA). The system equipment requiring special maintenance tools shall be identified.

3.5.1.1.6 Maintenance Personnel. Maintenance planning shall consider the levels of maintenance personnel. The ARTS IIIE shall be designed such that all corrective and periodic maintenance will use staffing at/or below the current levels throughout the equipment/system life.

3.5.1.2 Software Maintenance Requirements and Analysis. Analyses of the software maintenance requirements of the ARTS IIIE shall determine the most cost-effective maintenance support plan for each software and firmware item, including commercially available items. The software maintenance approach shall be efficient, making use of standardization, automation, and centralization. The integrated software maintenance process shall incorporate technical, management, and operational aspects. The technical aspects shall include sophisticated productivity software tools, practices and procedures, documentation, libraries, and maintenance performance measurements. The managerial aspects shall include staffing patterns, jurisdictional responsibilities, decision flow, management audits and control, cost accounting measurements and systematic organizational process flow. The operational aspects shall include user guides, operating and implementation instructions, test and certification procedures, and maintenance data acquisition.

3.5.1.2.1 Software Maintenance Types. Software maintenance is the performance of all software activities (correction, modification, extension, and enhancement) required to keep a system operational after completion of the development cycle. Software maintenance planning shall address the following categories of maintenance activities:

a. Perfective - maintenance performed to eliminate inefficiencies, enhance performance and/or improve maintainability.

b. Adaptive - maintenance performed in response to changes in data and processing environments.

c. Corrective - maintenance performed to correct failures in meeting performance criteria specified in the system design.

3.5.1.2.2 Maintenance Levels. Maintenance levels shall consist of the following:

a. Onsite Maintenance - Software maintenance at the ARTS IIIE shall be limited to software system version installation, local adaptation data base modification, test verification, report and identification of problems, collection of any supporting data.

b. FAA Technical Center Maintenance - The SSC shall be the focal point for creation and distribution of software system version releases to operational sites and providing diagnostic support to the sites.

3.5.1.2.3 Maintenance Activities. Maintenance planning and analysis shall consider the following activities for onsite and FAA Technical Center software maintenance. The analysis and planning shall address the cost effectiveness of the software maintenance methods.

3.5.1.2.3.1 Onsite Maintenance. Software maintenance at the operational site shall identify software problems, collect any supporting data, submit the problem description and data to the Technical Center for resolution, and modify the adaptation data base and submit the modifications to the Technical Center. In addition, the operational site shall receive new software versions from the Technical Center and test, verify, and certify that the new software or modifications to existing software are qualified for operational use. The operational site shall also support recovery servicing if necessary. These activities shall be performed for all operational, training, maintenance, and other Computer Software Configuration Items (CSCIs).

3.5.1.2.3.2 Support System. Software maintenance conducted at the FAATC shall include identifying problems, collecting supporting data, and reporting problems. In addition, updated software versions, including data bases and adaptation data files, shall be transmitted to operational sites. Software maintenance at the FAATC shall include all operational and support software for the ARTS IIIE. All necessary configuration management, documentation and quality control activities related to management of the software shall also be supported at the FAATC.

3.5.1.2.4 Maintenance Facilities. The support analysis and maintenance plans shall be used to identify facility requirements for standard and special support equipment, tools and test equipment, and software packages at the SSC facility to support maintenance of software. Software maintenance tools shall be built upon the base of tools used during design and implementation (paragraph 3.3.8) and shall be delivered complete with design and user documentation.

3.5.1.2.5 Maintenance Personnel. Software maintenance planning and analysis activities shall consider the skills and staffing levels of maintenance personnel.

3.5.2 Supply. Paragraph 3.5.2.1 provides overall background detail on the future FAA support system which will complement the new maintenance policy decision. Paragraph 3.5.2.2 specifies requirements which shall be met in support of the ARTS IIIE hardware.

3.5.2.1 Background. The FAA's maintenance supply guidelines are described in FAA Order 6000.30. LRI and parts deployment shall be identified as part of support analysis and maintenance planning as specified in 3.5.1.1. The LRI maintenance plans shall also be used to guide the development and acquisition of other elements of logistics: support equipment, equipment manuals, provisioning, technical documentation, and training.

The ARTS IIIE maintenance plan, in conjunction with the ARTS IIIE design, shall support the availability requirements specified in paragraph 3.2.5.

3.5.2.2 Supply. The range and depth of spares and repair parts required for maintenance, of new equipment shall be considered during design and development. The design shall minimize the introduction of new spares and repair parts into the Government inventory by using national stock numbered items wherever practical. Commonality of spares and repair parts shall be

maximized during development. Logistics support analysis shall be used to determine cost-effective solutions for alternate approaches. The spares and repair parts selection process shall ensure continued availability of spares and repair parts meeting the original manufacturer's specification over the product life of the system.

3.5.3 Facilities and Facility Equipment. The physical space within the ARTS IIIE facilities and FAA Technical Center is limited and as such may place certain constraints on the ARTS IIIE design. The government will provide no additional space than is currently available within the operational and equipment areas of the ARTS IIIE and FAATC facilities. The design of the ARTS IIIE shall not require the government to relocate its equipment currently in place, except in the case of equipment replacement, i.e., displays.

3.5.3.1 ARTS IIIE System. The ARTS IIIE and equipment shall be housed in building areas which are in accordance with the following paragraphs.

3.5.3.1.1 Location and Access. The ARTS IIIE shall be located on government-secured property. Facility access roads consist of solid surfaces capable of sustaining equipment laden vehicle loading conditions of the type which would be experienced in the transportation of ARTS IIIE type equipment. ARTS IIIE accessibility Design Criteria are also provided in FAA Standard drawings referenced in the following paragraphs.

3.5.3.1.2 Architecture and Configuration. The architecture and configuration of the ARTS IIIE facilities will be provided by the FAA in accordance with FAA Regional As Built Standard Drawing Series officially approved building modifications or drawings revisions thereof.

3.5.3.1.3 Physical Plant. The FAA will provide interior building space for offices, training, and maintenance support in accordance with standard space allocation formulas as specified in Title 41, Code of Federal Regulations, Federal Property Management Regulations, Part 101 and FAA Order 4660.1. Furnishings for this space will also be in accordance with these documents. Heating, ventilation, air conditioning, and other environmental controls (e.g., humidity, air filtration, etc.) will be provided in accordance with FAA Regional As-Built Standard Drawing series D-5906, E-5896, FAA Order 6480.7, and any officially approved building and equipment modifications and drawing revisions thereof. The ARTS IIIE system design shall identify any physical plant requirement for facility equipment which is not provided by the FAA.

3.5.3.1.4 Utilities. All control and equipment room locations will be provided with electrical power, lighting, and water in accordance with FAA Regional As-Built Standard Drawing Series and officially approved building and equipment modifications and drawing revisions thereof. Personnel offices, training, and maintenance support space will be provided with 120-volt ac, 60-Hz power receptacles, lighting, and adequate water and water closet facilities. Power lighting will be in accordance with Occupational Safety and Health (OSHA) standards. The system design shall identify any requirements for utilities for facility equipment which is not provided by the FAA.

3.5.3.1.5 Special Considerations. The FAA will provide special facility equipment not specified in the preceding paragraphs such as grounding, lightning, surge protection, and security systems for the ARTS IIIE in accordance with FAA Regional As-Built Standard Drawing Series and any officially approved building and equipment modifications or drawing revisions thereof.

The ARTS IIIE system design shall identify any requirements for special facility equipment for the ARTS IIIE which is not provided by the FAA.

3.5.3.2 System Support Computer (SSC). The SSC and facility equipment will be housed in a building area which is in accordance with the following paragraphs.

3.5.3.2.1 Location and Access. The SSC will be located on government-secured property at the FAATC near Atlantic City, New Jersey. Facility accessibility is provided in accordance with FAA Technical Center Plot Plan and Architectural Drawings from Contract 10 Atlantic City Improvement Authority (ACIA), Sheets 106 through 109 and any officially approved modifications or revisions thereof.

3.5.3.2.2 Architecture and Configuration. The architecture and configuration of the Technical Center area which will house the SSC will be in accordance with the Technical Center Architectural Drawings.

3.5.3.2.3 Physical Plant. The FAA will provide interior building space and furnishing as specified in paragraph 3.5.3.1.3. Heating, ventilation, air conditioning (HVAC) and other environmental controls (e.g., humidity and air filtration) will be provided to all SSC areas in accordance with the following Technical Center documentation; Contract Number 11 HVAC and piping drawings ACIA Sheets 303 through 306, 320 through 323 and any officially approved building and equipment modifications and drawing revisions thereof. The ARTS IIIE system design shall identify any physical plant requirements for facility equipment which is not provided by FAA.

3.5.3.2.4 Utilities. All SSC control and equipment room locations will be provided with electrical power, lighting, and water in accordance with the following Technical Center Documentation: Contract Number 13 Lighting and Power Drawings ACIA Sheets 416, 418, 421, 423, 436, 438, 441, 443, 481 through 484, Contract Number 17 ACIA Sheet 423, Contract Number 12 Plumbing Drawings ACIA Sheets 503 through 506, Sprinkler System Drawings ACIA Sheets 603 through 606, and any officially approved building and equipment modifications and/or drawing revisions thereof. The ARTS IIIE design shall identify the requirements for utilities for facility equipment which are not provided by the FAA.

3.5.3.2.5 Special Considerations. The FAA will provide special facility equipment not specified in the preceding paragraphs such as grounding, lightning and surge protection, and security systems for the ARTS IIIE in accordance with the following Technical Center documentation: NASP-5204-01 Volumes I and II, Contract Number 13 equipment grounding Drawings ACIA Sheet 474 and any officially approved building and equipment modifications and drawing revisions thereof.

The ARTS IIIE design shall identify any requirements for special facility equipment for the ARTS IIIE which is not provided by the FAA.

3.6 Personnel and Training.

The contractor shall develop a training program which will provide for an orderly transition from the current system to the ARTS IIIE and for its continued operation and maintenance.

3.7 Functional Area Characteristics.

The system level functional requirements are grouped into 7 Functional Areas. The Functional Area groupings and their breakdown into capabilities are presented solely for the purpose of providing a convenient, logical framework for the statement of specification requirements.

The requirements for the ARTS IIIE general terms specify requirements to:

a. Accept inputs from local and remote sources, including surveillance sensors, personnel at operating position, system monitor console, and centers.

b. Process the data and store it as appropriate into data bases of operational data, maintain the data bases, and protect the data from hardware and software failures and errors.

c. Disseminate operational and status information to personnel within the ARTS IIIE facility and remote towers and centers.

Many of the specifications herein are stated using the terminology, constraints, data item names, display formats, and input/output messages of the existing FAA automation system. Frequent reference is made to existing specifications, and narrative descriptions sometimes parallel the processing sequence of existing FAA systems. This is done only for ease and clarity of specification of functional requirements. The ARTS IIIE shall provide the functional equivalent or analog of the cited features of the existing system and that equivalence shall be explicitly identified in system documentation.

Adaptation, as used in this specification, means data that describe the geographical, operational, and physical environment within which a computer operates.

In addition to the functional requirements stated in this specification the system shall also comply with the developed transition requirements.

The basis for the ARTS IIIE program shall be the Government furnished A6.03 operational program. The contractor is precluded from modifying the basic algorithms of the GFP software except to improve their efficiency or enhance their operation. Any changes shall be submitted to the Government for review and approval prior to Critical Design Review (CDR).

3.7.1 ARTS IIIE. The ARTS IIIE systems functional requirements are divided into 7 areas: The CP, TP, DP, subsystem interface, system monitor console, coded time source and support software.

The ARTS IIIE functions as a minimum shall perform the functional capabilities which currently exist in the A6.03 ARTS IIIE system.

Other functional requirements which are common to all subsystems are:

a. Subsystem Recovery - When a failure occurs within a subsystem, recovery shall not cause a failure in other subsystems. If the subsystem element where the failure occurred is not dependent on nor depended upon by any other element in the subsystem then only that element shall be required to enter a recovery sequence, e.g., failure in an individual display in the DP subsystem shall only require recovery of that display not the total DP subsystem. The TP may request the CP to perform a clean start (recovery).

   Recovery shall be restricted to the lowest possible independent level in each subsystem. Where possible, recovery shall restore that subsystem or subsystem element to the configuration which existed immediately prior to the failure. Following this restoration it shall be available for update to the current situation. Each subsystem shall be capable of automatic recovery

when failures are detected in subsystem elements in the following situations:

(1) System Timeouts

(2) Power Failure

(3) Processor/Memory Failures

(4) Program Faults

b. System Timeouts - The capability to recover from a system timeout shall be provided. A system timeout is defined as the situation where a subsystem element(s) exceeds predetermined time(s) (SP) in any processing function. When this condition is detected in a subsystem, that subsystem shall initiate a restart after determining its available resources in terms of processors and memory.

c. Power Failure - The capability to recover from a power failure shall be provided. Whenever power on a subsystem element drops below a given level, the subsystem containing that element shall go into a recovery sequence. The subsystem shall determine its available resources in terms of processors and memory and automatically attempt a restart.

d. Processor/Memory Failures - The capability of the system to detect a failure in the hardware such as a memory or processor failure and attempt at automatic recovery shall be provided. When this occurs the subsystem containing the failed element shall enter a recovery sequence. The subsystem shall automatically determine its available processor and memory resources and if sufficient a restart shall be initiated.

e. Program Faults - The capability of the system to detect when a processor is in a program fault condition and attempt at automatic recovery shall be provided. The subsystem shall enter a recovery sequence, determine its available resources, reload necessary software and initiate a restart.

f. Recurring Failures - The ARTS IIIE system shall be capable of detecting the recurrence of failures in its subsystem hardware elements. Recurring failures are defined as N (SP) consecutive failures of the same hardware element within M (SP) recovery sequences. In the event this occurs, the subsystem shall be capable of isolating the failing element from the subsystem and activating an available redundant element. If the loss of the failing element results in a hardware configuration without the resources necessary to support system operation, the system shall recover using elements previously failed due to the recurring failures logic. This capability shall be provided in those subsystems having fail-safe/fail-soft capabilities in which a failure of any of the hardware elements (processor/memory) may cause the total subsystem to fail. Notification of this occurrence shall be presented to the system technician on a printer under control of the SMC.

g. Critical Data Inhibit (Cold Startup) - The system shall have the capability of automatic or manually initiated recovery with or without critical data. The capability to automatically recover without critical data shall be included so that when the

difference between the current time and the recorded critical data time exceeds a parameter (SP), the recovery will be accomplished without restoring critical data.

In all the above failure types (except power failure) the system shall be capable of recovery, including restoration of critical data (if applicable), (using either backup elements that are running in parallel or by loading of software into an idle redundant element) within 12 seconds. Power failure recovery time shall be 45 seconds or less. Following a successful recovery of the CP or TP subsystem, the subsystem fault log shall be presented on an SMC printer along with cause of failure and recovery system variables including system resource status.

3.7.1.1 Common Processor Subsystem (CP) Function. This section discusses the software requirements of the portion of the ARTS IIIE system which is referred to as the CP. The following functions shall provide as a minimum the capabilities which currently exist in the A6.03 ARTS IIIE Program.

The CP shall include but not be limited to the following:

MAJOR FUNCTIONS:

Intersubsystem Communications Message Processing (Section 3.7.1.1.1)

Conflict Alert (Section 3.7.1.1.3)
Minimum Safe Altitude warning (MSAW) (Section 3.7.1.1.4)
Interfacility Message Processing (Section 3.7.1.1.5)
Ground Plane Tracking (Section 3.7.1.1.6)

Tracking Support and Track File Maintenance (Section 3.7.1.1.8)
Track File Update and Maintenance (Section 3.7.1.1.9)
Auto Association of Flight Data to Track Data (Section 3.7.1.1.10)
Auto Disassociation of Flight Data from Track Data (Section 3.7.1.1.11)
Intersensor Linking of Tracking Data (Section 3.7.1.1.12)
Keyboard Processing and Display Update (Section 3.7.1.1.13)

Critical Data Recording (Section 3.7.1.1.15)
Continuous Data Recording (CDR) Extraction (3.7.1.1.16)
On Call Control (Section 3.7.1.1.17)
Performance Monitoring (Section 3.7.1.1.18)
Enhanced (Modular) Target Generator Processing (Section 3.7.1.1.19)
Retrack Processing (Section 3.7.1.1.20)
Beacon Radar Online Performance Monitor (Section 3.7.1.1.21)
Software Adaptation to Beacon System (SWABS-A) (Section 3.7.1.1.22)
Digital Map Processing (Section 3.7.1.1.23)

3.7.1.1.1 Intersubsystem Communications Message Processing. This function shall process all messages received from and transmitted to those subsystems which are external to the CP but contained within the ARTS IIIE. This function shall process incoming messages from the other subsystems, validate and route the message to the appropriate function, and table within the CP. The function shall also process and format messages generated from data internal to the CP for transmission to the external subsystems. Examples of outgoing messages to the external subsystem would be track status, time synch, and display updates. Example of incoming messages from the external subsystems would be sector times, target reports, track data, subsystem status, selected Sensor/SRAP data and keyboard messages.

3.7.1.1.2 Reserved.

3.7.1.1.3 Conflict Alert. This function provides an aid to the controller in detecting currently hazardous or potentially hazardous situations between pairs of aircraft. It accomplishes this by monitoring the separation in altitude and ground plane coordinates between tracked Mode C aircraft. It provides a visual and aural warning to the corresponding controller(s) when a conflict situation is detected. It also causes a message to be output to the ARTS IIIE SMC indicating the aircraft pair in conflict and other Pertinent data with respect to the conflict.

This function receives data from the altitude tracker and ground plane tracker for use in its algorithms consisting of a primary filter, linear conflict detector, proximity conflict detector and maneuvering conflict detector.

The capability to inhibit/select conflict alert processing of intersensor track pairs by sensor shall be provided.

3.7.1.1.4 Minimum Safe Altitude Warning (MSAW). This function provides an aid to the controller(s) when an aircraft under their control is at/or predicted to be at an unsafe altitude. MSAW monitors separation between aircraft and surrounding terrain/obstacles and generates a visual and aural alarm to alert the corresponding controller(s) if the aircraft is below or predicted to be below prescribed minimums with respect to the adjacent terrain/obstacles. The MSAW program is logically divided into 3 monitoring elements; general terrain monitor, approach path monitoring, and satellite airport monitoring. The MSAW program retrieves data from the central track store consisting of X, Y tracking data, and altitude tracker data for use in its algorithms. It uses this track data along with site adapted geographical terrain/obstacle data, and runway approach data to determine if an alert should be generated or not.

3.7.1.1.5 Interfacility Message Processing. This function interfaces with and processes messages received from and transmitted to its Air Route Traffic Control Centers (ARTCCs).

Interfacility data processed by this function consists of operational flight data, track data, test data and related responses.

Operational flight data received by the ARTS IIIE system from the ARTCC consist of flight plans, amendments, and cancellations. Operational flight data transmitted by the ARTS IIIE to the ARTCCs consists of departure and termination of beacon messages.

Track data messages exchanged between the ARTS IIIE and its associated ARTCCs are based on accurate positional and velocity data derived from processed radar data. Test data messages are exchanged between the facilities to monitor the performance of the full duplex interface. All operational flight data and test messages as well as most track data messages require and expect a timely response.

This function shall support ARTS/ARTCC, ARTCC/ARTS and ARTS/ARTS interfacility data processing and message transfers.

3.7.1.1.6 Ground Plane Tracking. This function provides tracking of all Mode C reporting aircraft in ground plane coordinates. It converts correlated report data from sensor oriented slant range coordinates to system ground coordinates using reported range and altitude computed by the altitude tracker. The Ground Plane Tracker then smooths this reported position with the current predicted position and saves this corrected position for next scan prediction by the Ground Plane Tracker. This ground track data is used by the Conflict Alert function in its computations. The Ground Plane Tracker also contains turn detection logic which provides indications of left or right

turns which are used by the Conflict Alert PROCON and NAAAM algorithms. This function shall provide at a minimum the capabilities which currently exist in the Ground Plane Tracker contained in A6.03.

Studies shall determine the tradeoffs between selection of the TP or CP for the residence of this function, with regard to data rates, efficiency, processor utilization and effectiveness.

3.7.1.1.7 Reserved.

3.7.1.1.8 Tracking Support and Track File Maintenance. This function accomplishes several tasks which are related to supporting the tracking and display functions. These tasks shall support tracks being processed from all sensors and shall include but are not limited to the following:

Track File update and Maintenance (Section 3.7.1.1.9)
Auto Association of Flight Data to Track Data (Section 3.7.1.1.10)

Auto Disassociation of Flight Data From Track Data (Section 3.7.1.1.11)
Intersensor Linking of Track Data (Section 3.7.1.1.12)

3.7.1.1.9 Track File Update and Maintenance. This function updates and maintains the Central Track Store track files which are resident in the CP data base. It receives data relative to these track files from the TP consisting of position, velocity, altitude, beacon code, and correlated report data. Data relative to these track files is also received from the Display Processing Subsystem (DP) such as, but not limited to track file modification, handoffs, track drops, suspends.

3.7.1.1.10 Auto Association of Flight Data to Track Data. This function shall automatically associate flight data containing discrete beacon codes to unassociated tracks having matching discrete beacon codes. The new associated track file is moved to the associated track list and will be displayed in Full Data Block (FDB) format on the corresponding controller's display. In addition, a message indicating the associated status of the track shall be formatted for transmission to the TP. Auto association shall be initiated as a result of meeting several criteria including discrete beacon code match between flight data and unassociated track data for SP consecutive scans. The unassociated track position must also be in a geographical auto association area corresponding to the arrival, overflight or departure status of the flight data.

3.7.1.1.11 Auto Disassociation of Flight Data from Track Data. This function automatically disassociates flight data from track data. This will occur when an associated track enters a geographical auto drop area corresponding to the track's arrival, departure, and overflight status. Velocity criteria is also included for arrivals.

3.7.1.1.12 Intersensor Linking of Track Data. This function shall link data between sensor subsystems for an aircraft being tracked in 2 or more sensor subsystems. This is necessary in order to eliminate overwrite of associated track symbology with unassociated track symbology and control display of associated track controller symbology. This function currently links associated tracks in their sensor subsystem to unassociated tracks in related sensor subsystems. Linking of tracks shall be done only when one of the set is associated.

The displaying of a pseudo track on a display associated with a secondary sensor shall be included as follows:

When an associated track in the primary sensor is known to be within the coverage of a secondary sensor, the program shall attempt to link the matching

tracks. If a match is not found a pseudo track shall be created in the secondary sensor. This concept guarantees that every associated track in one subsystem, within radar coverage of another subsystem will always be linked to a track in that subsystem.

3.7.1.1.13 Keyboard Processing and Display Update. Keyboard processing shall be shared by the TP, SMC, CP, and DP. Only those functions that directly affect an individual display shall be performed by the DP (see para. 3.7.1.3). All other keyboard functions shall be processed by the CP, TP and SMC. The capability of transferring data from the CP to the DP and visa versa shall be included.

Generally, keyboard entries with system wide impact will be processed by the CP. Information processed by the CP as a result of a keyboard entry shall be forwarded to the DP.

As a minimum, the CP shall provide information to the DP in order for the DP to update the displays with current information, the CP shall provide the DP with the following information:

a. System Data Area per ARTS IIIE NAS-MD-639.

b. Arrival/Departure List per ARTS IIIE NAS-MD-639.

c. Coast/Suspend List per ARTS IIIE NAS-MD-639.

d. BRITE TAB List per ARTS IIIE NAS-MD-639.

e. MSAW/CA List per ARTS IIIE NAS-MD-639.

3.7.1.1.14 Reserved.

3.7.1.1.15 Critical Data Recording. The capability shall exist to restore the system to the air traffic control situation that existed at the time the system entered the recovery mode. Critical Data shall be recorded on the disc subsystem for use after system recovery. Critical data shall include, but not be limited to, the most recent track data, system configuration, and system data including time, selected beacon codes, and software initialization parameters. Types of data collected and restored are contained in NAS-MD-647. Critical data shall be recorded at a minimum of once per scan.

3.7.1.1.16 Continuous Data Recording (CDR) Extraction. CDR extraction shall be automatically initiated at system startup with the extraction of all or preselected data types. Data types shall be selected via keyboard entry. CDR shall be provided in all automation modes. CDR shall function as described in ARTS IIIE NAS-MD-648.

3.7.1.1.17 On-Call Control. The CP shall process on-call program requests from the SMC. On-call programs shall not derogate any functioning of the operational program. The on-call programs are loaded from the disk and include the following:

- Limited Display Diagnostic Test (LDDT) - allows limited maintenance to be conducted on on-line displays.
- Disk to Disk Transfer (DTOD) - allows the copying of an RSL disk to a scratch disk.
- Scenario Disk Update (SCDU) - allows updating of disk scenarios from tape.

tracks. If a match is not found a pseudo track shall be created in the secondary sensor. This concept guarantees that every associated track in one subsystem, within radar coverage of another subsystem will always be linked to a track in that subsystem.

3.7.1.1.13 Keyboard Processing and Display Update. Keyboard processing shall be shared by the TP, SMC, CP, and DP. Only those functions that directly affect an individual display shall be performed by the DP (see para. 3.7.1.3). All other keyboard functions shall be processed by the CP, TP and SMC. The capability of transferring data from the CP to the DP and visa versa shall be included.

Generally, keyboard entries with system wide impact will be processed by the CP. Information processed by the CP as a result of a keyboard entry shall be forwarded to the DP.

As a minimum, the CP shall provide information to the DP in order for the DP to update the displays with current information, the CP shall provide the DP with the following information:

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c. Coast/Suspend List per ARTS IIIE NAS-MD-639.

d. BRITE TAB List per ARTS IIIE NAS-MD-639.

e. MSAW/CA List per ARTS IIIE NAS-MD-639.

3.7.1.1.14 Reserved.

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3.7.1.1.17 On-Call Control.
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- ~~Disk to Disk Transfer (DTOD) - allows the copying of an RSL disk to a scratch disk.~~
- ~~Scenario Disk Update (SCDU) - allows updating of disk scenarios from tape.~~

~~• Time Selected Output (TSO) - allows the transfer of time selected CDR data from disk to tape.~~ ~~• Time Selected Output (TSO) - allows the transfer of time selected CDR data from disk to tape.~~

3.7.1.1.18 Performance Monitoring. System Performance Monitoring is a function that shall be included in the CP. This function monitors the load and performance of the system during selected time periods. It provides information relative to track and target loads and processor utilization. If selected this data is outputted to the ARTS IIIE SMC on a periodic basis.

3.7.1.1.19 Enhanced Target Generator (ETG) Processing (Modular). This function provides simulating sensor/surveillance inputs for the purpose of system testing and controller training. The ETG shall be resident in the operational program. ~~The CP shall be capable of executing the ETG simultaneously with one other on-call program.~~ The capability shall exist to run the system in training mode which is a fully operational mode but with non-interfering training capability or in a test mode which is totally non-operational. In training mode, live operational data and training data are processed together internally but are segregated for display purposes; i.e., live and training data shall not be displayed together on the same controller display, conflict alert processing is not performed for mixed live and training track pairs, MSAW and CA alerts for training tracks do not energize the aural alarms.

In test mode the system is fully non-operational wherein all sensor/surveillance data must be provided by the ETG. This data includes but is not limited to beacon and primary radar target data, sensor azimuth data, noise, and blip/scan ratio.

In either test or training mode the above mentioned target data, target control, and operational keyboard commands can be scripted on disk or tape resident scenarios or entered manually from a display keyboard in training/test mode.

In either of the above modes the simulated target report data must be inserted into the system by the TP for processing by tracking. In test mode the system shall be totally driven by the ETG, therefore, sensor azimuth data (sector marks) must also be provided by the ETG and inserted by the TP into the system to provide timing for tracking and other functions.

In either of these modes scripted target control and operational keyboard commands shall be entered into the system for processing by the CP.

Studies in accordance with the Statement of Work (SOW) shall determine the tradeoffs between integration into the TP, CP or a standby processor for execution of this function. Items to consider include but are not limited to operational system interface requirements, biasing of the operational system, data rates, processor and memory requirements, system effectiveness.

3.7.1.1.20 Retrack Processing. ~~The CP shall support Retrack processing in accordance with A6.03.~~ The Retrack function shall provide the replaying of CDR data which was previously recorded during live operations and/or simulated using the ETG in a training or test mode into the system. The Retrack function shall drive the ARTS IIIE system during a totally nonoperational time period, yet in a mode not requiring the ETG. However, Retrack and the ETG shall run simultaneously with Retrack providing sensor azimuth (sector marks) and both Retrack and the ETG providing target data for insertion into the system by the TP. The Retrack function shall also play back all keyboard messages which are included in the CDR recordings. However, it shall be able to inhibit playback of individual keyboard messages by function and/or subfunction; e.g., the keyboard message multifunction, "R" may be inhibited

requested sensor's range, the associated full data block shall freeze on the display and blink "OR" in field 4. It shall appear at the original sensor's coordinates.

6. Digital map data for the affected displays will be replaced with data based on the newly selected sensor.

The SWABS-A keyboard entry shall be automatically executed when the Radar System Selector Switch (RSSS) is activated at a display. Based on the sensor selected on the RSSS, the appropriate keyboard entry shall be automatically generated to realign the display to the selected sensor digital data.

3.7.1.1.23 Digital Map Processing. The displays shall contain a series of internal video maps in non-volatile (EEPROM) storage. These maps shall contain basic information based on each sensor for use in an emergency mode.

These shall be controlled by a series of interlocking pushbutton switches on the display which shall provide none, any one, or any combination of the six selected maps.

The displays shall also contain Random Access Memory (RAM) for storage of digital maps which shall be downloaded from an external Processor. These maps shall be tailored to the position of operation, runway in use configuration, and broadband sensor pairing. It shall be possible to overlay additional map information such as terrain contours, and emergency information to the basic operational map. These additional overlays shall be downloaded along with the basic map and reside in display memory. Call up of the mapping information in RAM shall be through keyboard entry. These maps shall be used in the normal mode of operation.

When the broadband sensor/display pairing is changed, the SWABS-A function, in addition to its current function, shall also consult a configuration table to determine what alternate map data shall be loaded into the display. This determination shall be based upon display function (associated with controller symbols) radar sensor pairing and runway in use, as applicable.

In addition to the automatic selection of map, it shall be possible, through keyboard entry, for the controller to select a different map set.

3.7.1.2 Track Processing Subsystem (TP) Functions. This section discusses the software requirements of that portion of the distributed ARTS IIIE System referred to as the TP.

The TP software shall include but not be limited to the following major functions:

- Parallel SRAP Processing (Section 3.7.1.2.1)
- Target processing (Tracking) (Section 3.7.1.2.2)
- ASR-9 RADAR Processing (Section 3.7.1.2.3)
- Intersubsystem Communications Message Processing (Section 3.7.1.2.4)
- Performance Monitoring (3.7.1.2)
- Altitude Tracking (3.7.1.2.5)

In addition, all data base parameters, tables and buffers necessary to support the above listed functions must be included; (e.g.), target report stores, abbreviated CTS, tracking parameters.

The TP shall process sensor related data provided by functions such as Training, X-Test, and Retrack. In Training Mode the system remains operational but processes both sensor/surveillance input data and simulated target data from the ETG. In X-Test Mode the system is fully in a test condition with the ETG simulating all sensor/surveillance related data to drive the system in place of Sensor/SRAP input data. Retrack is similar to X-Test in that it provides all sensor/surveillance related data to drive the system in place of the digitized Sensor inputs. However, the data Retrack uses to drive the system is from previously recorded CDR data rather than ETG data.

System Performance Monitoring is a function that shall be included in the TP subsystem. This function monitors the load and performance of the system during selected time periods. It provides information relative to track and target loads and processor utilization. If selected this data upon request is outputted to the ARTS IIIE SMC on a periodic basis.

The TP shall support Retrack processing in accordance with A6.03.

3.7.1.2.1 Parallel SRAP Processing. This function shall provide an interface with and process data from the Sensor Receiver and Processor (SRAP). This function shall include as a minimum but not be limited to the parallel SRAP processing function interface and processing capabilities which currently exist in the ARTS IIIE System. This function interfaces with and processes data from all dual SRAPs. It receives, processes and stores sector and target data by sensor for further processing by the target processing (Tracking) function. SRAP alarms received and error conditions detected are stored for output to the ARTS IIIE SMC. This function shall detect SRAP subchannel failure and automatically switch to the alternate subchannel or backup SRAP.

Sector and target data are also stored for transfer to the SMC for CDR recording and other functions. These messages received from the SRAP(s) will be processed by the TP subsystem.

3.7.1.2.2 Target Processing (Tracking). This function shall initiate new track files and maintain proper correlation between target data and their corresponding track files. This shall be a track all system (including primary radar targets), initiating and maintaining track files for all aircraft within the radar coverage area of each sensor. In addition to the above, it shall otherwise reflect the existing ARTS IIIE tracking philosophy. The tracker shall be modular in design and include, but is not limited to, the following tracking functions:

a. Tracking Executive (TEXEC)

b. Track Early Discrete Correlation (TEDC)

c. Track/Target Cross Referencing and Scoring (TCROSS)

d. Track Primary/Secondary Correlation (TPSEC)

e. Track Initial/Trial Correlation (TINIT)

f. Process Unused Reports (TPUR)

g. Track Prediction (TPRED)

The Auto Association/Disassociation of flight data to track data and the corresponding site adapted tables shall be contained in the CP.

Intersensor linker shall be included in the CP.

3.7.1.2.3 ASR-9 RADAR Processing and I/O Interface. This function shall interface with and process sensor and surveillance data received from the ASR-9 system via the Surveillance Communications Interface Processor (SCIP). The data shall be formatted and passed on to the parallel SRAP processing function for further processing.

Refer to ASR-9 Radar Interface Requirements Para. 10.1.1

Refer to Parallel SRAP Processing Function Para. 3.7.1.2.1

3.7.1.2.4 Intersubsystem Communications Message Processing. This function processes all messages received from and transmitted to those subsystems which are external to the TP but contained within the ARTS IIIE system. This function will process incoming messages from the other subsystems, validate and route the message to the appropriate function table within the TP. This function will also process and format messages generated from data internal to the TP for transmission to the external subsystems. Examples of incoming messages from the external subsystem are track status, time synch, target generator data, and Retrack data. Examples of outgoing messages to the external subsystems would be sector times, target reports, track data, subsystem status and selected Sensor/SRAP data.

3.7.1.2.5 Altitude Tracking. This function provides altitude tracking for all Mode C equipped aircraft within the sensor coverage area of each of the sensors in the ARTS IIIE system. This function shall include as a minimum but shall not be limited to the altitude tracking function (including Mode C unreasonableness logic) which currently exists in the A6.03 ARTS IIIE system.

This function processes reported Mode C altitude data received from the SRAP input processing function in the TP subsystem.

This function provides altitude tracking data for use by the Conflict Alert and MSAW functions. It also determines reported Mode C altitude reasonableness for use by the display output function in inhibiting the display of erroneous reported altitude in a track's full data block.

3.7.1.3 Display Processing Subsystem (DP) Function. The DP shall perform selected keyboard and display functions. The DP shall drive displays at the TRACON and at remote towers. The DP function shall be resident within microprocessor embedded displays specified in FAA-E-2747.

The DP is responsible for preparation of display data for presentation on the corresponding controller display. The DP is also responsible for accumulating keyboard inputs from the controller and sending appropriate controller entries to the CP, TP, or SMC for action.

The DP shall support Retrack processing in accordance with A6.03.

3.7.1.3.1 DP Data Base. The intelligent displays shall have appropriate tables, lists, and files readily available so that dedicated DP functions can be processed independently. As a minimum the DP shall contain the following data:

1. CTS display related data for the sensor to which the display is assigned.
2. Quick Look Tables
3. Auto-Offset Tables
4. Leader Offset Tables

5. Altitude Beacon Filter Tables

6. Tabular List Tables

7. System Data Area Tables

8. Digital Range Marks Table

9. Digital Map Tables

3.7.1.3.2 Program Structure. All logically independent functions shall be segmented into separate subprograms (tasks). Changing, deleting, or adding to one or more subprograms without affecting the remaining subprograms shall be included.

3.7.1.3.3 Display Processing. The functional capabilities of display output processing shall remain, as a minimum, as described in ARTS IIIE NAS-MD-639.

The display output tasks shall be divided into separate subroutines in order to effectively handle the variety of data to be presented and to meet the individual update frequencies required for the various data.

3.7.1.3.3.1 Tabular Lists. The displaying of up to 26 lines in the arrival departure tabular list plus 32 lines in the coast/suspend list shall be included.

3.7.1.3.3.2 Display Presentation. The data to be handled by each display may be divided into eight separate categories:

1. Active associated aircraft (two or three line FDB or single symbol)

2. Inactive Flight Data (tabular lists)

3. Unassociated aircraft (LDB or single symbol)

4. System data (alphanumeric)

5. Keyboard Preview and Readout Data (alphanumeric)

6. Trackball Position (symbol)

7. MSAW/CA Alert Display Area (tabular lists)

8. BRITE Tabular Lists

These data shall retain the format used in the GFP A6.03 ARTS IIIE Operational Program.

3.7.1.3.3.3 Keyboard Processing. The functions of Keyboard Input Processing (KIP) and Keyboard Operational Function (KOF) processing shall remain, as a minimum, as described in ARTS IIIE NAS-MD-638.

In addition, a software quicklook feature shall be added which allows the quicklooking of up to 15 positions separately or simultaneously.

The KIP/KOF program shall process all keyboard interrupts, preview all input messages, and process all operational function requests. Operational function requests relate to track control, flight data, display control, system parameters, system configuration, implied functions, memory inspect and change, and enhanced target generation.

3.7.1.3.3.3.1 KOF Functions. As a minimum the following KOF functions will be performed by the display processor:

1. Display Altimeter (F7,A)
2. Beacon Code Readout (F7,B)
3. E/I Select Beacon Codes (F7,B)
4. E/I Full Data Block Readout (F7,D)
5. Modify filter limits (F7, F)
6. Reinitialize Display (F7,K)
7. Modify Leader Direction (F7,L)
8. Enable Auto Offset (F7,O)
9. Relocate TAB Lists (F7, P, S, TM, TC, P1, P2 or T)
10. Select/Inhibit Display of Arrival/Departure Tab List (F7,T) Enter

3.7.1.3.3.4 Reserved.

3.7.1.3.3.5 Enhanced Target Generator. Displaying of targets generated by the ETG shall be included. The ETG shall accept commands from display keyboards to simulate the flight paths, control the mode, and control the characteristics of up to 64 independent targets.

3.7.1.3.3.6 Automatic Offset. The Automatic Offset Function (selectable at each display by keyboard entry) shall meet the requirements of ARTS IIIE NAS-MD-639, Section 8.

The full data blocks (FDB) at each display shall be periodically checked to determine if FDB overlap exists. If overlap is detected, the offset of one of the FDBs shall be changed. No attempt shall be made to prohibit an associated track format from overlapping with unassociated track readouts, tabular lists, preview data, or single symbols (representing other associated or unassociated aircraft). Also, no attempt shall be made to prohibit crossing leaders. When the overlap condition no longer exists, the data block shall be returned to its initial position.

In addition to the above criteria, the Auto Offset Function shall provide the following:

a. For Tower Displays (BRITEs, etc.), it shall attempt to resolve overlap of all full data blocks viewed on those displays whether controlled there or not.

b. For FDAD displays, no attempt shall be made to resolve FDB overlap situations where neither FDB is controlled at that display. However, in overlap situations where at least one or both of the pair is controlled at that display an attempt to resolve the overlap shall be made. If one FDB of the pair is not controlled at this display, then an attempt will be made to reposition that FDB to resolve the situation.

3.7.1.3.3.7 Continuous Data Recording. Recording entered keyboard functions and display data shall be included. Data shall be prepared and forwarded to the SMC for output to the recording media.

3.7.1.3.3.8 System Performance Monitoring. System Performance Monitoring is a function that shall be included in the DP. This function monitors the load and performance of the system during selected time periods. It provides information relative to display processing utilization data. When selected, this data is outputted to the ARTS IIIE SMC on a periodic basis.

3.7.1.3.3.9 Display Processing Intersubsystem Communications Message Processing. This function processes all messages received from and transmitted to subsystems within the ARTS IIIE that are external to the DP. This function will process incoming messages from the other subsystems, validate and route the message to the appropriate function/table within the DP. This function will also process and format messages generated from data internal to the DP for transmission to external subsystems. Examples of incoming messages from the external subsystem would be tracking data, system data area information, and data pertinent to keyboard functions performed external to the DP.

Examples of outgoing messages to the external subsystems would be CDR data and data pertinent to keyboard functions performed in the DP.

3.7.1.3.3.10 DP Hardware Design. For the hardware design characteristics of the Full Digital ARTS Display refer to FAA specification FAA-E-2747.

3.7.1.3.3.10.1 Remote Display Processor. The Remote Display Processor for the DBRITE shall interface either with the DBRITE located at the TRACON or at a remote tower. No modification to the DBRITE equipment shall be made. MTBF calculations for a local DBRITE tower shall be done on a 1 of 2 model for each tower.

3.7.1.4 Subsystem Interface Functions. This section discusses the intersubsystem interface requirements with regard to the communications between those subsystems contained within the ARTS IIIE system.

3.7.1.4.1 Full Up Operational System. The system shall provide two- way communications between all subsystems of the ARTS IIIE system. These communications shall consists of the required protocol, operational data messages, interface test messages, and message responses. Each subsystem shall process, format, transmit, receive, and decode those messages which are pertinent to the functions residing in that subsystem. All messages received shall be validated with regard to proper format before insertion for operational use. Messages containing errors shall be discarded and a retransmission of the identified message shall be requested of the originator. If the error persists for a (SP) number of times, it shall be identified and recorded on the ARTS IIIE SMC.

Interface hardware and/or communications failures detected shall be identified and recorded on the ARTS IIIE SMC for notification of the condition. The failed hardware shall be automatically isolated and a standby backup unit (if available) shall automatically take over in its place. If a standby unit does not exist, the system shall degrade to a lower mode of operation. The system resource status shall be updated to reflect this change in configuration. Failed units shall be recovered back into the operational system in accordance with the logic in A6.03 which has specific manual and/or automatic recovery dependent on the type of unit. Restoration/recovery of a failed unit shall be done without degradation of the system. The current status of system resources shall be displayed at the SMC.

3.7.1.4.2 Subsystem and/or Interface Failure. Within each subsystem, failure to receive data, either operational or test, from any other subsystem for a prescribed length of time shall result in a communications failure being declared for that particular interface. If the failure continues for a prescribed length of time that interface shall be declared down. A message

3.7.1.3.3.7 Continuous Data Recording. Recording entered keyboard functions and display data shall be included. Data shall be prepared and forwarded to the SMC for output to the recording media.

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including drive number; e.g., disc drive 2 or tape drive 1, and also the capability to select/deselect recording of data by type, e.g., select Tracking Data (TD), deselect Keyboard Functions (KF), etc. This function shall automatically switch recording of data from one drive to another in the event of a drive failure or a full disc or reel. This occurrence shall be presented on the ARTS IIIE System Monitor Console.

3.7.1.5.2 External Time Source. The SMC shall interface with and process data from an external time source. Synchronization shall be provided by a WWVB Receiver. This shall be digitally coded time with a granularity of 1/1000 of a sec or finer. This digital time shall be available to all subsystems of the ARTS IIIE system. It shall be used for time synchronization between the subsystems to provide for sequential time tagging of messages transferred between the subsystems and other interfaces. These include but are not limited to the interfacility interface, system time, continuous data recording, critical data recording, and ARTS IIIE SMC. Antenna redundancy shall not be considered in calculation of MTBF, MTTR or availability.

3.7.1.6 Support Software. The support software shall provide, at a minimum, semi-automated support functions and shall operate concurrent with the operational program in the ARTS IIIE normal mode.

If three different programming languages are used, support software for all three shall provide all the programs needed to support the ARTS IIIE system. Use of these programs shall not degrade the ARTS IIIE Normal Mode operation.

3.7.1.6.1 Assembler. The assembler(s) shall provide as a minimum all the capabilities of the existing ARTS IIIA assembler as described in PX-6196 ARTS III Support Software User's Guide.

3.7.1.6.2 Builder. The builder shall provide the loading and linking all the executive modules, tasks and data bases that make up an operational program for the ARTS IIIE.

The utility program for the system shall provide a convenient, efficient means of building, modifying, and inspecting an organized set of programs for the ARTS IIIE.

3.7.1.6.3 Utility Program. The utility program shall bootstrap load the absolute formatted portions of the builder from a storage media. The utility program shall utilize these portions of the builder for loading and for the builder utility functions (e.g., inspect, change, dump, store constant, and assign features).

3.7.1.6.4 Recovery System Library. A recovery system library shall contain an organized set of programs, a directory, and a recovery module.

3.7.1.6.5 Continuous Data Recording (CDR) Editor. The editor program shall provide a formatted, printed output of data recorded by the CDR extractor and shall be available to the operator either by using the off-line equipment, or as an on call program.

3.7.1.6.5.1 Equipment Configuration. CDR shall process extracted data from all storage media for output to a high speed printer. Control of the editor operation shall be from the SMC.

3.7.1.6.5.2 Data Types. The editor shall selectively print data as specified in NAS-MD-646.

3.7.1.6.5.3 Filters. A filter is a parameter or range of values for which the data editing shall be in effect. This shall enable the operator to examine specific data without having to printout all extracted data. The CDR editor filters shall be as described in ARTS IIIE NAS-MD-646.

3.7.1.6.5.4 Beacon Data Reduction. Beacon data reduction shall be provided with the editor and shall include the following:

a. A printout of all duplicate beacon reports for any scan in which a duplicate report is found.

b. A printout of all duplicate beacon reports of any selected code block for any scan in which a duplicate is found.

c. A printout of all duplicate beacon reports of any selected discrete code for any scan in which a duplicate is found.

d. A summary printout of each scan that contains the total number of Mode 3/A targets, and the total number of Mode C targets.

3.7.1.6.5.5 Editor Control. Message inputting from the ARTS IIIE SMC shall be provided for operator control of the editor and shall include but not be limited to:

a. A selection of any combination of the data types listed in section 3.7.1.6.5.2.

b. A selection of any combination of the filters and data types affected by the filter listed in section 3.7.1.6.5.3.

c. A selection of any combination of the beacon data reduction categories listed in section 3.7.1.6.5.4.

d. A command to stop all printing at the next scan. The command shall reinitialize the program to wait for further operator commands.

Whenever possible selection shall be single key action. It shall be possible to designate several selections within a single input message.

3.7.1.6.5.6 Output. Labels (Column Headings) shall be provided for each data type and category of data within a data type. These labels or column headings shall be printed out on each page.

Azimuth data shall be printed in Azimuth Change Pulses (ACPs) and degrees.

Sector time shall be printed in hours, minutes, seconds, and milliseconds.

Data loss messages shall be printed when detected.

3.7.1.6.6 Memory Mapper. A memory mapper program shall be provided for mapping operational software.

3.7.1.6.7 Source Cross Reference Listing. This program shall produce an alphabetically sorted cross reference listing of symbols found by scanning a collection of source files. It shall produce a listing of the symbols found, the files, and the lines on which they occur.

3.7.1.6.8 Off-Line Programs. The following off-line utility programs shall be updated, if needed, to operate with the new system.

ELTOXY - Latitude/Longitude Conversion to X/Y Coordinates - NASP-2501-01.

ESG - Enhanced Scenario Generator.

3.7.1.6.9 Diagnostic Software. The contractor shall provide the details of diagnostic definition and the point of execution in the Hardware Requirements Specification. System and subsystem diagnostics shall be provided as per paragraphs 3.7.1.6.9.1 and 3.7.1.6.9.2. For diagnostics executed by the SMC, either of the two nonactive SMCs shall have the capability of running one of the resident programs simultaneously with the other node (nonactive) being able to run the same or different program.

3.7.1.6.9.1 Systems Diagnostics. A system diagnostic/monitor test shall be supplied. The purpose of the system diagnostic/monitor shall be to (a) ascertain the operability of equipment functions associated with the systems and provide a maintenance tool which shall exercise the system to nearly the same degree as the operational program and to isolate problems which may occur under this level of exercise.

The system diagnostic shall be modular in nature. That is, any combination of subprograms can be added to achieve the degree of system verification desired. As a minimum the system diagnostic program shall be comprised of the following test subprograms:

a. Diagnostic Monitor Subprogram

b. Processor Subsystem Subprogram

c. Memory Unit Subprogram

d. Data Entry and Display Subprogram

e. Remote Tower Display and Data Entry Subprogram (The diagnostic for the remote tower display may reside in the display processor associated with that display.)

f. Interfacility Communications Multiplexor Subprogram

g. Mass Storage Subsystem Subprogram

3.7.1.6.9.2 Subsystem Diagnostics. The contractor shall supply a separate set of equipment-oriented diagnostic programs which operate "off-line" and "on-line" for all equipment. These diagnostic programs shall include the features necessary to meet the equipment maintainability requirements specified. As a minimum, diagnostics shall be provided for each system which will isolate failures down to the LRI.

a. Processors

b. Memory Module

c. Interfacility Communications Multiplexor

d. Disc Subsystem

e. Data Entry and Display Subsystem

f. Printer

g. Remote Tower Display and Data Entry Subsystem

h. LAN (subsystem communication)

i. SMC

The diagnostics shall provide for complete testing, monitoring, and evaluating of all logical/programmable functions within the module under test. The diagnostics shall detect 95 percent of all failures and provide isolation of 75 percent of those single, nonintermittent LRI malfunctions. (Isolation shall be to a single PCB.) In equipment where cards are not employed, malfunctions shall be isolated to a group of three replaceable circuit elements. This isolation shall be accomplished using a combination of automatic and manual procedures. The detect/isolate percentages shall apply to newly developed software.

Manual call-up of diagnostics shall be provided to be used in an off-line mode. This means that no operations shall occur in the module under test at the time the module diagnostic is being executed. Each program shall assume that all modules necessary for test use, except the module under test, are in proper operating order. All execution of these diagnostics shall be from the appropriate maintenance console.

3.7.1.6.10 Debug Aids. The debug aids are programs which may be used in the program development and program maintenance efforts to assist in the isolation of program related problems. The debug module is a removable part of the program. The other debug aids described below are self-contained programs which may be loaded with the operational program.

3.7.1.6.10.1 Debug Module. The debug module shall be a removable segment of the program intended for use at the SSC. The debug module provides the programmer with the tools for the integration and checkout of a program task. The debug module as a minimum shall provide the following functions:

a. Software Breakpoint - This function shall enable or disable a breakpoint, the processor shall be placed in a suspended state. It shall be possible to request any debug function following a breakpoint hit.

b. Program Segment Timing - This function shall determine the elapsed time between the execution of two specified timing breakpoints and provide output timing statistics on the printer.

c. Snap Dump - This function shall output immediately the contents of a limited area of memory whenever a processor reaches a specified memory address. It shall selectively output to the high speed printer, ARTS IIIE SMC, or storage media.

d. Change Memory - This function shall change the content of a specified memory word to the data value specified by the user. The old and new data values shall be printed following the change.

e. Dump Memory - This function shall search a specified area of memory for a selected bit configuration and print the address of each find.

f. Suspend Processor - This function shall cause the requested processor(s) to enter a suspended state with task processing discontinued. A suspended processor shall remain available for processing of other debug requests and resume processing upon command.

g. Register Dump - This function shall output the content of pertinent registers at a selected breakpoint.

h. Trace Function - This function shall collect/print selected memory addresses and data registers.

3.7.1.6.10.2 Miscellaneous Debug Aids. These debug aids shall be included in the operational tasks. These debug aids shall be as follows:

a. Print Memory - Output the contents of the memory area specified by a start and end address in the processor register to the high speed printer.

b. Write Bootstrap Format - This program shall write the contents of the specified area of memory onto tape in bootstrap format.

c. Search Core - This program shall search the contents of the specified area of memory for a particular masked value.

3.7.1.6.11 Librarian Program. The Librarian Program shall provide the operator all the tools needed to maintain the source coding used to create the operational program; i.e., updating source disc/tapes, disc to disc copy.

3.7.1.6.12 Event Recorder. The Event Recorder shall collect and record ARTS IIIE program task execution timing data. At a minimum, the Event Recorder which is currently available for the ARTS IIIE system shall be included. The Event Recorder is executed in conjunction with the ARTS IIIE operational system executive. Recording of Event timing data is selected at a display keyboard and recorded on the RSL disk for the CP subsystem or the PLD for the TP subsystem.

Reduction/formatting of Event data is accomplished via the Event editor software tool.

3.7.1.6.12.1 Event Editor. The Event Editor shall reduce and format event data which was recorded online. At a minimum the capabilities which are currently available for the ARTS IIIE for reducing/formatting Event data shall be included. The formatted output data is presented on a high speed printer and consists of several timing variables including individual ARTS IIIE system task execution time maximums and averages. Data is also presented with respect to percentage of processor utilization for execution of tasks, dead time, inactive time, and overhead.

3.7.1.7 Reserved

4. QUALITY ASSURANCE PROVISIONS.

The ARTS IIIE shall be developed and produced in accordance with Quality Assurance (QA) provisions that shall provide continuing system verification throughout the acquisition phase of the ARTS IIIE procurement program. These provisions shall ensure that engineering design and development are complete, that design risks are minimized, and that all delivered hardware, software, and documentation meet specified requirements. The QA provisions shall also ensure that the methods of design, construction, inspection, and testing provide early detection of deficiencies and assure prompt, effective corrective action.

Throughout this program, special attention and emphasis shall be directed toward assuring a quality product. Formal QA plans and procedures, which are Contractor prepared and FAA approved, shall be applied to the ARTS IIIE System. The Contractor's QA program shall include a hardware quality control system to monitor all delivered materials and equipment, and a software quality control system to monitor all delivered software in accordance with the articles of the contract.

In addition, end item and in-process tests will be conducted to verify that ARTS IIIE hardware and software meet the requirements of Section 3 of this specification.

All elements of the development program will be monitored and evaluated by a Government Independent Verification and Validation (IV&V) team.

The following paragraphs contain requirements on QA, testing, and verification methodology.

4.1 General. The contractor shall lead the quality assurance effort and be responsible for all hardware and software provided in the system. The contractor shall ensure that standards for software and hardware design and fabrication are followed and that all subcontractor and vendor items are in accordance with all contract requirements. All QA activities shall be in accordance with approved QA plans.

4.1.1 Quality Management and Responsibilities. The quality assurance program shall be managed by the Contractor and reviewed by the Government IV&V team. The major responsibilities of each of those organizational elements are as follows:

a. The Contractor has overall responsibility for the final system and the QA procedures used.

b. Subcontractors' assurance organizations assure compliance with prime contractor-developed and Government-approved QA plans.

c. The Government's acquisition and material organization monitors and approves contractor QA activities.

d. The IV&V team monitors QA activities of the prime contractors and subcontractors, assesses those activities, and makes recommendations.

4.1.1.1 Contractor. The Contractor will plan, establish, and maintain a QA program in accordance with the articles of the contract. The contractor's responsibilities shall include:

a. Developing the required quality assurance plans plus all necessary test plans, descriptions, procedures, and data collection forms.

b. Conducting all necessary reviews and audits.

c. Ensuring that all necessary input test data scenarios, support equipment, and software are available and ready for required tests.

d. Conducting all necessary tests at Contractor facilities and onsite tests at Government facilities as required by contract.

e. Documenting all required tests on test data collection forms and reporting analyses and interpretation of test results following completed tests.

f. Correcting any deficiencies detected and retesting as necessary after corrections are made.

g. Assuring that the subcontractor's and vendor's QA Program and plans are in accordance with the Contractor's program and plans and are acceptable and that those plans are rigidly followed.

h. Assuring that all goods and services furnished by vendors meet specified requirements.

4.1.1.2 Government Responsibilities. Government responsibilities include:

a. Monitor the overall QA Program to ensure its effective implementation and operation.

b. Review and approve all Contractor supplied QA plans plus all necessary test descriptions, procedures, scenario data, and data collection forms.

c. Oversee the operation and maintenance of GFE. Contractor responsibilities for GFE operation and maintenance shall be specified in the ARTS IIIE contract.

d. Provide representatives to observe all tests requiring a Government witness.

e. Provide any required Government-supplied scenario data for test/evaluation.

f. Review and take action as appropriate on recommendations made by the IV&V team.

g. Conduct independent demonstration testing and evaluation to assess the performance of the delivered system and the system's readiness for operational testing and evaluation.

h. Provide independent operational testing and evaluation to assess the operational readiness of the delivered system.

i. Inspect subcontracted goods and services at subcontractors' facilities at the Government's option.

4.1.1.3 IV&V Team. The IV&V team is a technical extension of the program manager and provides direct support to him. Duties and responsibilities include:

a. Evaluating the prime contractor's QA program from the standpoint of assuring the technical accuracy or credibility of the data initiated by or reported through the QA system.

b. Validating traceability of hardware and software design requirements from the basic program requirements.

c. Performing ongoing assessments of the QA program to assure technical accuracy of the data initiated by or reported through to QA system.

d. Analyzing test data and validating test results.

e. Providing periodic and special reports and recommendations to the Government.

4.1.2 Quality Controls. The quality controls identified in this section ensure the quality of the system, hardware and software developed under this program. Throughout the entire ARTS IIIE development period, inspections, reviews and audits will be applied on an ongoing basis to ensure the quality of the product. Included shall be system requirement reviews, system design reviews, test readiness reviews, and others identified in MIL-STD-1521, and as specified in the contract.

Formal testing will be used to verify that the design(s) meet the requirements of this specification. These tests will be conducted at subcontractor, prime contractor, and FAA facilities. Tests by the subcontractor and contractor will demonstrate adherence to specifications and verify readiness for delivery. Tests by the FAA will verify acceptability of the system and assess operational usability.

4.1.2.1 Hardware Quality Control Program. A hardware quality control system shall be established and maintained in accordance with FAA-STD-016, Quality Control System Requirements. The hardware quality control system shall provide for inspection and testing according to written standards of quality which specify definitive, measurable criteria to enable such inspections and tests to confirm compliance with these standards and assure that all delivered materials and equipment meet contract requirements. Included are control of purchased material procedures to ensure the acceptable quality of subcontractors' and other suppliers' equipment, and test control procedures for each configuration item to ensure the validity of all tests and results.

The Hardware Quality Control plan shall also include review and audit requirements of MIL-STD-1521 and the contract. The plan shall also address hardware documentation quality control in accordance with paragraph 1-4 of FAA-D-2494/1.

The configuration management requirements of FAA-STD-021 augmented by MIL-STD-483 and documented in an FAA-approved configuration management plan, will provide the configuration controls through which all test plans and other documentation will be released.

4.1.2.2 Software Quality Control Program. A software quality assurance program shall be established and maintained in accordance with FAA-STD-018. The software quality assurance program shall provide for reviews and audits, and testing of all delivered software throughout the contracted development period to ensure that all delivered software and documentation meet contract requirements.

Written standards of quality shall be established which specify definitive, measurable criteria to enable inspections and tests to confirm compliance with these standards and assure that delivered software meets contract requirements. Included are controls to be applied to software documentation, test documentation and other documentation.

The configuration management requirements of FAA-STD-021 augmented by MIL-STD-483, are to be used. A separate configuration management plan, as a supplement to the software quality assurance plan, is required and shall be developed by the contractor in accordance with the SOW.

4.1.3 Design Reviews and Configuration Audits. The ARTS IIIE design shall be reviewed at key points during the contract, following MIL-STD-1521 and the SOW, to assess the progress of the development process and the quality of the evolving system. The reviews and audits shall include:

a. System Requirements Review (SRR)

b. Preliminary Design Review (PDR)

c. Critical Design Review (CDR)

4.2 Conformance Tests. This section contains requirements for the conformance testing program. This program shall demonstrate that the ARTS IIIE performs in accordance with all applicable specifications. In order to adequately test and evaluate the ARTS IIIE, both the Contractor and FAA must be involved in the

testing. The testing will be spread among Contractor, FAA Technical Center, and the operational facility. These will involve a multiplicity of test environments.

Subsequent paragraphs contain discussions on the FAA's test philosophy, objectives, facilities, documentation, and program.

The testing philosophy must be predicated upon the concept that ARTS IIIE testing will guarantee the accuracy and reliability of the output.

4.2.1 Test Philosophy. The FAA's test philosophy for the ARTS IIIE procurement is: (1) a series of thorough and sufficient tests shall be performed by various organizations to test the ARTS IIIE from multiple perspectives; and, (2) various reviews of the design shall be accomplished during design, development, and test.

Major test series include Contractor tests in-house and at the FAA Technical Center, FAA production acceptance tests and evaluations (PAT&E) at the Technical Center, and FAA operational tests and evaluations (OT&E) at the Technical Center and at the operational facility.

In addition to direct Contractor and FAA evaluation of tests, the designated IV&V team will conduct evaluations of all and/or specified system/subsystem tests to provide the FAA with assurance that the ARTS IIIE performs as specified.

ARTS IIIE testing shall be based on a build approach that takes a defined subset of ARTS IIIE requirements and verifies compliance of that build with its requirements before proceeding to the next higher level of integration. Functional capabilities of each successive build increase until the final build implements all ARTS IIIE requirements.

This testing approach combined with testing from different perspectives, independent review and evaluation, and strict adherence to a quality control program will ensure that an ARTS IIIE is deployed in compliance with all requirements.

The approach to testing shall conform to the philosophy described above.

4.2.2 Test Objectives. The FAA has three main test objectives: (1) to ensure an orderly progression of system development and testing that is demonstrable and verifiable; (2) to ensure that the ARTS IIIE meets all system requirements; and, (3) to ensure that transition from the current systems to the ARTS IIIE is safely and effectively achievable with minimal impact to controllers. PAT&E objectives therefore include:

1. Ensuring that all delivered items have been properly produced, installed, and operate as specified.

2. Demonstration, through system checkout up to Initial Operating Capability (IOC), that installation has been successful and in accordance with specifications.

3. Verification that specified quality has been produced.

4. Verification of specified consistency from item to item.

5. Demonstration that support items such as simulators, logistics, support equipment and manuals are technically compatible and according to specification.

6. Verification of specified safety.

7. Determination of whether the system meets reliability specification.

8. The accumulation and provision of data to refine the logistics supportability of the system.

4.2.3 Test Facilities. There shall be three types of test facilities: (1) Contractor in-plant facility, (2) FAA Technical Center, and (3) FAA operational facility.

4.2.3.1 Contractor Facility. The test facilities at the Contractor's plant shall support designated levels of required testing during the ARTS IIIE design phase.

The facility shall support various levels of hardware and software functional testing and performance tests. The facility shall support the use of simulators for testing in order to provide a realistic environment for the unit being tested. The facility shall support reliability or maintainability demonstrations and data collection as laid out in the RMA Program Plan. The facility shall support testing under all applicable environmental conditions. Data reduction and analysis capability shall exist at the facility to evaluate recorded test data.

Support for any GFP required for test activities at the Contractor's plant shall be provided as specified in the contract.

4.2.3.2 FAA Technical Center. The test facility at the FAA Technical Center will support Contractor and FAA testing during the ARTS IIIE integration phase. The Test Facility will support all tests performed at the Technical Center including tests to check system conformance to requirements, tests under the maximum capacity workload, installation, integration and certification testing.

The Facility will contain office space and office equipment for contractor use. The Test Facility will support Contractor maintenance of Contractor equipment and FAA maintenance of GFP as specified in the contract.

Support will be provided for data collection and reduction of test data as specified in the contract.

4.2.3.3 FAA Operational Facility. The FAA operational facility will support the installation, integration, checkout, and certification testing of the system.

The facility will also support training activities of controllers and maintenance personnel. The facility will support maintenance of equipment and collection and reduction of data.

The facility will contain office space and office equipment for Contractor personnel as specified in the contract.

All testing shall be done with the equipment on non-critical power in accordance with FAA Order 6950.15, Critical Power for ARTCCs.

4.2.4 Test Documentation. Test documents are required to plan, describe, conduct, and report results of all tests on the system. Test documentation shall include test plans, test descriptions, test procedures, and test reports which are described in paragraph 3.4.3 of this specification.

4.2.5 Test Program. The test program for the ARTS IIIE shall be structured in accordance with each program phase. The testing performed during each phase is divided among Contractor and FAA tests at the Contractor's facilities, at the FAA Technical Center, and at the FAA operational facility.

PAT&E, SOST and special tests and demonstrations shall be conducted on the ARTS IIIE to verify that all functional and performance requirements are met. The following is a preliminary list of tests that shall be conducted by the Contractor during PAT&E:

a. Contractor preliminary tests

b. Design qualification test (first production article only)

c. Type tests on environment (first production article only)

d. Burn-in tests

e. Hardware/software unit tests

f. Hardware/software integration tests

g. System-level functional and performance tests

h. Reliability/maintainability demonstration

i. Support, diagnostic and repair capabilities demonstration

j. Factory acceptance test

k. Installation and checkout tests

The following is a preliminary list of tests that shall be conducted by the Contractor during SOST:

a. Field site installation and checkout tests

b. Field site integration and test (required to demonstrate readiness prior to FAA operational test and evaluation)

Special tests and demonstrations shall be conducted in accordance with the contract.

4.3 Methodology. This section contains requirements for the methodology used to verify adherence of the system to specified requirements.

The verification methods identified herein shall be applicable to all requirements identified in this specification.

The methods used for verification of a requirement shall be inspection, analysis, demonstration, and test. Testing shall be used wherever possible, and shall be used for verification of all requirements at the system level. These terms are defined in subsequent sections. Each requirement and the method of verification shall appear in tabular form, and will be generated by the Contractor in accordance with the articles of the contract.

The verification requirements shall be mandatory for use in all testing of the ARTS IIIE system. Verifications require witnessing by the FAA (or designated representative) whenever performed by the Contractor and are conducted in accordance with FAA-approved test plans, descriptions, and procedures. Pass/Fail criteria for each requirement verified will be defined by the Contractor in accordance with the contract and placed in the appropriate test documentation. A failure to meet the "Pass" criteria of any verification action (inspection, analysis, demonstrations, or test) shall be allowed during verification. Upon evaluation of the cause of the failure and correction

thereof, the verification in which the failure occurred shall be repeated. If the corrective action has an impact on prior verifications, if a computer program is changed, or if hardware is changed, then the prior verifications shall be repeated.

Subsequent paragraphs contain definitions of each method of verification.

4.3.1 Inspection. Inspection is verification by visual examination of the item, reviewing descriptive documentation, and comparing the appropriate characteristics with a predetermined or referenced standard to determine conformance to requirements without the use of special laboratory equipment or procedures.

4.3.2 Analysis. Analysis is verification by technical/mathematical evaluation or simulation using mathematical representation (i.e., mathematical models, algorithms, equations, charts, graphs, circuit diagrams, data reduction/recording and representative data) to prove that an item meets specified requirements. Representative data may include data collected from previous or other equipment and system verifications.

4.3.3 Demonstration. Demonstration is verification by operation of the item in performing its design functions under a specific set of conditions. The item may be instrumented and quantitative performance may be monitored and recorded. A determination that the demonstration is satisfactory will be indicated; this may be based upon satisfactory limits of performance.

4.3.4 Tests. Test is verification through systematic exercising of the item under all appropriate conditions, with instrumentation and collection, analysis, and evaluation of quantitative data for predetermined performance characteristics. Acceptability of the item is determined by the comparison of the data with preestablished quantitative requirements and occurrences.

4.3.5 Verification Method Summary. This paragraph shows how the verification method of the ARTS IIIE requirement shall be presented. The information shall be presented in the form of a Verification Method Summary Table. The table contains the following information:

a. Paragraph number and title of each requirement specified in paragraphs 3.2 through 3.7 and Section 10 of this specification.

b. Testing location at which verification of compliance with each requirement has been or shall be performed. Subheadings listed under each of the test locations shall have an "x" placed in the appropriate column. This signifies that verification of compliance shall be performed utilizing Inspection (I), Analysis (A), Demonstration (D), or Test (T) methods.

5. PREPARATION FOR DELIVERY.

The ARTS IIIE shall be prepared for delivery after successful completion of all factory tests in accordance with the approved Installation Plan. It shall be packaged in accordance with best commercial practices for insuring arrival at the destination in an undamaged condition. The method of transportation shall be consistent with the packaging. All installation, operation, and maintenance documentation identified in paragraph 3.4 shall be included. All special tools and test equipment shall be included.

6. NOTES.

This section contains a list of acronyms and definitions designed to promote understanding but is not contractually binding.

6.1 Acronyms.

AC	Alternating Current
ACIA	Atlantic City Improvement Authority
ACID	Aircraft Identification
AFSS	Automated Flight Service Station
AFTN	Aeronautical Fixed Telecommunications Network
AMA	Assistant Manager for Automation
AMTS	Assistant Manager for Technical Support
A/N	Alpha/Numeric
ANSI	American National Standards Institute
ARSR	Air Route Surveillance Radar
ARTCC	Air Route Traffic Control Center
ARO	Airport Reservations Office
ARTS	Automated Radar Terminal System
ARTS IIIE	ARTS III Expanded
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATCT	Airport Traffic Control Tower
ATIS	Automatic Terminal Information Service
AT&T	American Telephone and Telegraph
BRITE	Brite Radar Indicator Tower Equipment
BROPM	Beacon Radar On-Line Performance Monitor
BTL	Beacon Tracking Level
BTU	British Thermal Unit
CA	Conflict Alert
CARF	Central Altitude Reservation Facility
CD	Common Digitizer
CDR	Continuous Data Record
CDR	Critical Design Review
CDTSO	Time Selected Continuous Data Recording Output
CFR	Code of Federal Regulations
CI	Configuration Item
CM	Corrective Maintenance
CP	Common Processing Subsystem
CRT	Cathode Ray Tube
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
CTA	Calculated Time of Arrival
CTS	Central Thread Store
CTS	Central Track Store
DA	Data Acknowledge
DBRITE	Digital Bright Indicator Tower Equipment
DCCU	Digital Communications Control Unit
DME	Distance Measuring Equipment
DP	Display Processing Subsystem
DPS	Distributed Processing System
DTOD	Disk to Disk Transfer
DT&E	Development Tests and Evaluations
EC	Engineering Change
EEPROM	Electrically Erasable Programmable Read-Only Memory
EIA	Electronic Industries Association (formerly RTMA)
EPROM	Erasable Programmable Read Only Memory
ETA	Estimated Time of Arrival
ETE	Estimate Time En Route
ETG	Enhanced Target Generator

FAA	Federal Aviation Administration
FAATC	FAA Technical Center
FAR	Federal Aviation Regulation
fc	footcandles
FDAD	Full Digital ARTS Display
FDB	Full Data Block
FDE	Flight Data Entry
FDEP	Flight Data Entry and Printout
FDIO	Flight Data Input/Output
fl	footlamberts
FP	Flight Plan
FPDU	Flight Plan Disk Update
FPM	Feet Per Minute
FSAS	Flight Service Automation System
FSP	Flight Strip Printer
FSS	Flight Service Station
GFE	Government-Furnished Equipment
GFP	Government-Furnished Property
GSA	General Services Administration
HF	High Frequency
HOL	High-Order Language
HVAC	Heating, Ventilation, Air Conditioning
Hz	Hertz
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
ID	Identification
IDENT	Identification
IEEE	Institute of Electrical and Electronic Engineers
IFC	Interfacility Communication Processing
IFR	Instrument Flight Rules
ILS	Integrated Logistics Support
ILS	Instrument Landing System
I/O	Input/Output
IOPB	Input/Output Processor, Model B
IOC	Initial Operating Capability
IR	Infrared
ISO	International Standards Organization
IV&V	Independent Verification and Validation
KF	Keyboard Function
KIP	Keyboard Input Processing
KOF	Keyboard Operational Function
kt	Knot
KV	Kilovolt
Kw	Kilowatts
LAN	Local Area Network
LDB	Limited Data Block
LDDT	Limited Display Diagnostic Test
LRI	Lowest Replaceable Item
LRSC	Lowest Replaceable Software Component
LSA	Logistics Support Analysis
m	Meters
MALS	Mediums Intensity Approach Lights
MD	Memory Dump
MIL-HDBK	Military Handbook
MIL-STD	Military Standard
MLS	Microwave Landing System

mm	millimeter
MMI	Man-machine Interface
MSAW	Minimum Safe Altitude Warning
MTBF	Mean Time Between Failure
MTR	Mitre Technical Report
MTTR	Mean Time to Restore or Repair
NAS	National Airspace System
NASP	National Airspace Plan
NAVAID	Navigational Aids
NEC	National Electrical Code
NFDC	National Flight Data Center
NFSG	National Field Support Group
nm	nautical miles
OJT	On the Job Training
OR	Out-of-Range
OSHA	Occupational Safety and Health Administration
OSI	Open Systems Interconnect
OT&E	Operational Tests and Evaluations
PAR	Precision Approach Radar
PCAB	Processor Cabinet
PDR	Preliminary Design Review
pf	picofarad
PM	Periodic Maintenance
PPM	Parts per million
PRF	Pulse Repetition Frequency
PAT&E	Production Acceptance Tests and Evaluations
PVD	Plan View Display
QA	Quality Assurance
RAM	Random Access Memory
R&D	Research and Development
RDBM	Remote Display Buffer Memory
RFP	Request for Proposal
RMA	Reliability, Maintainability, and Availability
RMMS	Remote Maintenance Monitoring System
RMS	Root Mean Square
ROM	Read Only Memory
RSL	Recovery System Library
RSSS	Radar System Selector Switch
RT&BTL	Radar Tracking and Beacon Tracking Level
SAAS	Stand-Alone Assembly System
SCDU	Scenario Disk Update
SID	Standard Instrument Departure
SMC	System Monitor Console
SMU	Solid State Memory Unit
SP	System Parameter
SOST	System Onsite Test
SSC	System Support Computer
SOW	Statement of Work
SPS	System Performance Specialist
SRAP	Sensor Receiver and Processor
SRR	Short Range Radar
SRR	System Requirements Review
SSF	System Support Facility
SWABS-A	Software Adaptation to Beacon System

TA	Terminal Arrival
TBD	To be Determined
TCROSS	Track/Target Cross Referencing and Scoring
TD	Tracking Data
TD	Terminal Departure
TEDC	Tracking Early Discrete Correlation
TEXEC	Tracking Executive
TI	Track Initiate
TINIT	Track Initial/Trial Correlation
TP	Track Processing Subsystem
TPRED	Track Prediction
TPSEC	Track Primary Second Correlation
TPUR	Process Unused Reports
TRACAB	Terminal Radar Approach Control in Tower Cab
TRACON	Terminal Radar Approach Control Facility
TSO	Time Selected Output
TTY	Teletype
VFR	Visual Flight Rules
VOR	Very High Frequency Omnidirectional Range
VORTAC	VOR/Tactical Air Navigation
WVD	Weather Video Digitizer

6.2 Glossary of Terms.

Active Flight Plan - All flights for which an actual departure time or arrival time has been entered.

Active Sector - A sector providing air traffic control in one or more assigned fix posting areas.

Active Time - An actual arrival time, an actual departure time, or an estimated arrival time included in the flight plan.

Adaptation - Unique site-dependent data required by the operational program to provide the flexible capability necessary to allow it to function at individual sites.

Adjacent Facility - A facility whose assigned airspace borders that of the facility being discussed.

Airline B TTY - A teletypewriter circuit (network) to which airline operations offices are connected.

Airport Surveillance Radar/ASR - Approach control radar used to detect and display an aircraft's position in the terminal area. ASR provides range and azimuth information but does not provide elevation data. Coverage of the ASR can extend up to 60 miles.

Airport Traffic Control Service - Air traffic control service provided by an airport traffic control tower for aircraft operating on the movement area and in the vicinity of an airport.

Air Route Surveillance Radar/ARSR - Air route traffic control center (ARTCC) radar used primarily to detect and display an aircraft's position while en route between terminal areas. The ARSR enables controllers to provide radar air traffic control service when aircraft are within the ARSR coverage. In some instances, ARSR may enable an ARTCC to provide terminal radar services similar to but usually more limited than those provided by a radar approach control.

Air Route Traffic Control Center/ARTCC - A facility established to provide air traffic control service to aircraft operating on an IFR flight plan within controlled airspace and principally during the en route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft.

Air Traffic - Aircraft operating in the air or on an airport surface other than loading ramps and parking areas.

Air Traffic Clearance - An authorization by air traffic control, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace.

Air Traffic Control/ATC - A service that promotes the safe, orderly, and expeditious flow of air traffic, including airport, approach, and en route air traffic control.

Air Traffic Control Facility - A facility that provides air traffic control service.

Air Traffic Control Radar Beacon System/ATCRBS - See Secondary Radar/Radar Beacon/ATCRBS.

Air Traffic Controller - A person authorized to provide air traffic service. Refers to en route and terminal control personnel.

Airway - A control area or portion thereof established in the form of a corridor, the outline of which is defined by radio navigation aids.

Approach Control Facility - A terminal ATC facility that provides approach control service in a terminal area. (See Approach Control Service).

Approach Control Service - Air traffic control service provided by an approach control facility for arriving and departing VFR/IFR aircraft and, on occasion, en route aircraft. At some airports not served by an approach control facility, the ARTCC provides limited approach control service.

Assembly - A number of basic parts or subassemblies, or any combination thereof, joined together to perform a specific function. Typical examples are: electric generator, audio-frequency amplifier, power supply, keyboard.

Assigned Altitude - An altitude assigned to an aircraft to be maintained during the flight. The aircraft will climb or descend to that altitude modified by any altitude restrictions given to the aircraft. An assigned altitude is given to a flight upon initial clearance delivery, but can be modified by controllers.

Automated Radar Terminal Systems/ARTS - The generic term for several terminal automation systems. Each differs in functional capabilities and equipment. ARTS plus a suffix roman numeral denotes a specific system. A following letter indicates a major modification to that system. In general, for the terminal controller, an ARTS displays aircraft identification, flight plan data, other flight associated information, e.g., altitude and speed, and aircraft position symbols in conjunction with his radar presentation. Normal radar co-exists with the alphanumeric display. In addition to enhancing visualization of the air traffic situation, ARTS facilitate intra/interfacility transfer and coordination of flight information. These capabilities are enabled by specially designed computers and subsystems tailored to the radar and communications equipments and operational requirements of each automated facility. Modular design permits

adoption of improvements in computer software and electronic technologies as they become available while retaining the characteristics unique to each system.

a. ARTS IIA - A programmable, nontracking, Computer aided display subsystem capable of modular expansion. ARTS II systems provide a level of automated air traffic control capability at terminals having low to medium activity. Flight identification and altitude may be associated with the display of secondary radar targets. Also, flight plan information may be exchanged between the terminal and ARTCC.

b. ARTS III - The Beacon Tracking Level (BTL) of the modular programmable automated radar terminal system in use at medium to high activity terminals. ARTS III detects, tracks, and predicts secondary radar derived aircraft targets. These are displayed by means of computer-generated symbols and alphanumeric characters depicting flight identification, aircraft altitude, ground speed, and flight plan data. Although it does not track primary targets, they are displayed coincident with the secondary radar as well as the symbols and alphanumerics. The system has the capability of communicating with ARTCCs and other ARTS III facilities.

c. ARTS IIIA - The Radar Tracking and Beacon Tracking Level (RT&BTL) of the modular, programmable, automated radar terminal system. ARTS IIIA detects, tracks and predicts primary as well as secondary radar-derived aircraft targets. This more sophisticated computer-driven system upgrades the existing ARTS III system by providing improved tracking, continuous data recording, and failsoft capabilities.

Automatic Update - An update of time information in a flight plan carried out automatically by the computer as a result of its having detected an "out of association longitudinally" condition.

Center - Same as Air Route Traffic Control Center (ARTCC).

Center's Area - The specified airspace within which an Air Route Traffic Control Center provides air traffic control and flight advisory service.

Collimation - The alignment of search and beacon radar returns from the same radar. The search radar is moved to the beacon position.

Collimation Error - The difference in range and azimuth between search and beacon signals from the same target using a common radar pedestal.

Combining/Decombining - Adapting to traffic loading. At least two, but usually not more than three sectors, are combined when converting from day to night watches. This is a short-term operational rearrangement of sectors and does not involve any change in wiring to the positions.

Common Digitizer - Equipment suitable for the automatic detection, correlation, and transfer of aircraft target information derived from long-range primary surveillance radars and radar beacon systems. See Weather Video Digitizer (WVD).

Control Sector - An airspace area of defined horizontal and vertical dimensions for which a controller or group of controllers has air traffic control responsibility, normally within an air route traffic control center or an approach control facility. Sectors are established based on predominant traffic flows, altitude strata, and controller workload. Pilot-controller communications during operations within a sector are normally maintained on discrete frequencies assigned to the sector.

Controlled Aircraft - Aircraft that are participating and receiving traffic separation service from the ATC system.

Controlled Track - A track which pairs with a flight plan in the system. This is generally a track for a controlled aircraft, but this is not necessarily always true.

Controller - See Air Traffic Controller.

Correlation - The process whereby targets are assigned to (correlated with) tracked aircraft. Correlation criteria usually include a code agreement and a distance criterion.

Crosstell - A track under control of one system (e.g., ARTS III) in the process of being transferred to, although not yet accepted by, another adjacent facility (e.g., NAS). Data concerning the track are sent across to the receiving facility.

Data Entry Device - Devices located at the controller's console which are used to enter data into the ARTS IIIE.

Departure Control - A function of an approach control facility providing air traffic control service for departing IFR and, under certain conditions, VFR aircraft. (See Approach Control Service).

Discrete Code/Discrete Beacon Code - As used in the Air Traffic Control Radar Beacon System (ATCRBS), any one of the 4096 selectable Mode 3/A aircraft transponder codes except those ending in zero zero; e.g., discrete codes: 0010, 1201, 2317, 7777; non-discrete codes: 0100, 1200, 7700. Non-discrete codes are normally reserved for radar facilities that are not equipped with discrete decoding capability and for other purposes such as emergencies (7700), VFR aircraft (1200), etc.

Duplex - Pertaining to a twin, a pair or two-in-one situation, i.e., a channel providing simultaneous transmission in both directions or a second set of equipment to be used in the event of failure of the primary or either device.

Established Airways/Routes - Preplanned and/or published airways or routes not requiring "on-the-spot" computation by the controller to determine airspace to be protected. These include:

a. Airway/Federal Airway - A control area or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids.

b. A direct route, locally charted by a facility for sector use but not disseminated in the FARs, and its associated protected airspace plus any turning-radius airspace.

Estimated Time of Arrival/ETA - The estimated time of arrival is the time the pilot expects to arrive at his destination based on the actual time of departure and the estimated time en route (ETE).

Exit Fix - The last fix of a standard instrument departure (SID) or coded route; also the fix from which a transition is made from a SID or coded route to the transition fix.

FDAD - The FDAD (Full Digital ARTS Display) is a display which can interface with the ARTS IIIA or ARTS IIIE systems. When interfaced with the ARTS IIIE the FDAD does its own display processing.

Field - A set of one or more characters that is treated as a whole; a unit of information.

Fix - A geographical position determined by visual reference to the surface, by reference to one or more radio NAVAIDs, by celestial plotting, or by another navigational device.

Flight Data Entries - Flight Plan data displayed on the Flight Data Display.

Flight Data Entry and Printout/FDEP - equipment which contains, as a minimum, a Digital Communications Control Unit (DCCU), an alphanumeric keyboard and a flight strip printer.

Flight Plan - Specified information relating to the intended flight of an aircraft that is filed orally or in writing with an FSS or an ATC facility.

Group - A collection of units, assemblies, or subassemblies which is a subdivision of a set or system, but which is not capable of performing a complete operational function. Typical examples are: antenna group, indicator group, the sector suite is a group.

IFR Aircraft - An aircraft conducting flight in accordance with Instrument Flight Rules.

Instrument Flight Rules/IFR - Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan. (See Visual Flight Rules, Instrument Meteorological Conditions).

Interfacility - Between adjacent facilities.

Intrafacility - Within a single facility.

Joint Use Restricted Areas - A restricted area within which IFR and/or VFR flight operations may be authorized by the controlling agency (an FAA facility) when not in use by the using agency.

Junction - A point where a direct route, airway, or coded route intercepts another direct route.

Microwave Landing System/MLS - An instrument landing system operating in the microwave spectrum which provides lateral and vertical guidance to aircraft having compatible avionics equipment.

Mockup - A model suitable for use in evaluating human factors relating to the physical size, form, location and fit of various groups, units and assemblies. It shall be of the physical dimensions and shape of the production model but may not be constructed using the same materials or processes. The model is not required to perform any electrical or performance functions. The groups, units and assemblies i.e., keyboards, track balls, and displays shall be individually removable and shall be of the same form, fit, dimensions, and weight proposed for the production model.

Mode 3/A - An interrogation mode in which a beacon radar transponder automatically reports identification when interrogated by a ground station. There are 4096 possible identification codes.

Mode C - An interrogation mode in which a beacon radar transponder automatically reports altitude when interrogated by a ground station.

NAS Plan - Document published periodically by FAA/DOT, which contains a description of the current National Airspace System and improvements to NAS that are currently planned.

National Airspace System/NAS - The common network of U.S. airspace air navigation facilities, equipment and services, airports or landing areas, aeronautical charts, information and services, rules, regulations and procedures, technical information, manpower, and material. Included are system components shared jointly with the military.

Non-discrete Code - A radar beacon Mode 3/A a four octal digit code in which the last two digits are zeros. Nondiscrete codes are normally reserved for radar facilities that are not equipped with discrete decoding capability and for other purposes such as emergencies (7700) and VFR aircraft (1200).

Pairing - The process whereby it is determined that both a flight plan and a track exist for a flight.

Position - Location of aircraft.

Primary Radar - A radar system in which a minute portion of a radio pulse transmitted from a site is reflected by an object and then received back at that site for processing and display at an air traffic control facility.

Prototype (Preproduction) Model - A model suitable for complete evaluation of mechanical and electrical form, design and performance. It shall be of final mechanical form (including the final configuration), employ approved final parts, and be completely representative of final equipment.

Quick Look - A feature which allows the controller the capability to display full data blocks of tracked aircraft from other control positions.

Radar Messages - Radar data from the SRAP are accepted into the computer storage for processing.

Radar Service - A term which encompasses one or more of the following services based on the use of radar which can be provided by a controller to a radar-identified aircraft:

a. Radar Separation. Radar spacing of aircraft in accordance with established minima.

b. Radar Navigational Guidance. Vectoring aircraft to provide course guidance.

c. Radar Monitoring. The radar flight following of aircraft, whose primary navigation is being performed by the pilot, to observe and note deviations from its authorized flight path, airway, or route. When being applied specifically to radar monitoring of instrument approaches, i.e., with precision approach radar (PAR) or radar monitoring of simultaneous ILS approaches. It includes advice and instructions whenever an aircraft nears or exceeds the prescribed PAR safety limit or simultaneous ILS no transgression zone.

Registration Error - Bias errors between the positions of targets as detected by different radar sites.

Search - See Primary Radar.

Secondary Radar/Radar Beacon/ATCRBS - A radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching

transmitter/receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This reply transmission, rather than a reflected signal, is then received back at the transmitter/receiver site for processing and display at an air traffic control facility.

Software - The term software shall include firmware as well as software.

Subassembly - Two or more basic parts which form a portion of an assembly or a unit, replaceable as a whole, but having a part or parts which are individually replaceable.

System - A combination of two or more subsystems, generally physically separated when in operation, and such other units, assemblies, and basic parts necessary to perform an operational function or functions.

System Support Computer/SSC - The equipment and software located at the FAA Technical Center which provides direct support to the field sites to resolve problems and which supports test of hardware and software modifications.

Target - Any discrete object which reflects or transmits energy back to the radar equipment. Also, the indication shown as a radar display resulting from a primary radar return or a radar beacon reply.

Technical Center - The FAA Technical Center located near Atlantic City, NJ.

Terminal Area - A general term used to describe airspace in which approach control service or airport traffic control service is provided.

Tower/Airport Traffic Control Tower - A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area. Authorizes aircraft to land or takeoff at the airport controlled by the tower and to transit the airport traffic area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services (radar or nonradar). (See Airport Traffic Control Service, Approach Control/Approach Control Facility, Approach Control Service, Tower En Route Control Service).

Tower En Route Flight - A flight that is not controlled (at any time) by an ARTCC. In general, it is a flight which is provided departure and arrival service by one or more terminal area facilities. There are two types in the high density NAS Terminal area: (a) intrafacility (arrives and departs within the NAS Terminal area), (b) interfacility (arrives from, or departs to, an airport outside the NAS Terminal area).

Track - The projection on the earth's surface of the path of an aircraft.

Trackball - Positional identification device available to the controller for identifying an X, Y position on the FDAD.

Tracking - A process which uses primary/beacon radar data and paired flight data (if any) to determine the actual position and velocity of a flight. Radar target identification through manual or automatic means; positional agreement of a radar target and the computer predicted position; computation of the difference between the predicted position and the actual position of the radar target.

Trail - The history of radar targets of an aircraft over the surface of the earth.

Transfer of Control - The action whereby the responsibility for the separation of an aircraft is transferred from one controller to another.

Transferring Controller/Facility - A controller/facility transferring control of an aircraft to another controller/facility.

Transition Altitude - A Mode C altitude determined by the program to be a reported altitude for a descending or ascending flight.

Transition Area - Controlled airspace extending upward from 700 feet or more above the surface of the earth when designated in conjunction with airway route structures or segments. Unless otherwise limited, transition areas terminate at the base of the over lying controlled airspace.

Transponder - The airborne radar beacon receiver/transmitter portion of the Air Traffic Control Radar Beacon System (ATCRBS) which automatically receives radio signals from interrogators on the ground, and selectively replies with a specific reply pulse or pulse group only to those interrogations being received on the mode to which it is set to respond.

Uncontrolled Aircraft - Those aircraft not participating in or receiving traffic separation service from the ATC system. This term does not include those flights receiving control service from control towers having only visual surveillance in performing control service.

Unit - A major building block for a set or system, consisting of a combination of basic parts, subassemblies, and assemblies packaged together as a physically independent entity. Typical examples are: radio receiver, radio transmitter, electronic power supply, and antenna. The common console and the auxiliary display are elements.

Unpaired Flight Plan - A flight plan for which the computer program is not maintaining a track (for instance when a flight is below radar coverage). (See Flight Plan).

VFR Aircraft - An aircraft conducting flight in accordance with Visual Flight Rules.

VFR Conditions - Weather conditions equal to or better than the minimum for flight under visual flight rules.

Visual Flight Rules/VFR - Rules that govern the procedures for conducting flight under visual conditions. The term "VFR" is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan. (See Instrument Flight Rules, Instrument Meteorological Conditions).

VOR/Very High Frequency Omnidirectional Range Station - A ground/based electronic navigation aid transmitting very high frequency navigation signals, 360 degrees in azimuth, oriented from magnetic north. Used as the basis for navigation in the National Airspace System. The VOR periodically identifies itself by Morse Code and may have an additional voice identification feature. Voice features may be used by ATC or FSS for transmitting instructions/information to pilots.

VORTAC/VHF Omnidirectional Range/Tactical Air Navigation - A navigation aid providing VOR azimuth, TACAN azimuth, and TACAN distance measuring equipment (DME) at one site. (See TACAN, VOR).

WWV - Radio station run by the National Bureau of Standards which transmits pulse enabling the listener to determine zone time (longitude) accurate to a small fraction of a second.

7. Not used.

8. Not used.

9. Not used.

10. INTERFACES.

This section describes the interfaces of the ARTS IIIE and SSC with other facilities that are part of the National Airspace System (NAS). It provides a further elaboration of the information contained in paragraph 3.1.5.

For the purposes of this specification, an interface is defined as the analog or digital informational exchange between ARTS IIIE and another NAS facility or system. The description of each interface includes the identification of the facility or system interfaced with ARTS IIIE and identification and description of the information or messages exchanged.

Interfaces to equipment that will be collocated with the ARTS IIIE as well as interfaces to equipment and facilities external to the ARTS IIIE are identified in this section. Intra-ARTS IIIE interfaces (e.g., ARTS IIIE-SRAP, ARTS IIIE-ASR-9) are identified and defined at a high level. These interfaces and the messages exchanged are derived from the functional requirements identified within this specification. The specific messages, their format and content, and the physical interface shall be defined as part of the ARTS IIIE design. This section also does not include any man-machine interfaces. Primary and backup power sources, HVAC equipment, and other similar interfaces with the ARTS IIIE are specifically excluded from this section.

The remainder of this section specifies the facilities, systems, and equipment that will be interfaced with the ARTS IIIE. This element of the specification describes, from an operational viewpoint, not only what specific communications interfaces are employed by the ARTS IIIE and the data or messages that are exchanged, but also the reasons for this data exchange. Included in this paragraph is a reference to appropriate ICDs if they are available. Table 10.1-7 identifies in summary form, the computers, systems, and equipment with which the ARTS IIIE will interface and provides references to the Section 10 descriptions.

Table 10.1-7. ARTS IIIE Interfaces

Interface	Reference Document
ARTS IIIE to ASR-9 (10.1.1)	FAA-E-2704 ASR-9 Specification
ARTS IIIE to SRAP (10.1.1)	ARTS IIIE NAS-MD-636 Parallel SRAP Processing PX-12104 Vol. 1-4 SRAP Technical Manuals
ARTS IIIE to ARTCC (10.1.2)	ARTS IIIE NAS-MD-640 Interfacility Data Transfer

10.1 ARTS IIIE Interfaces.

10.1.1 Surveillance Sites - ARTS IIIE Operational and Physical Interface. The ARTS IIIE shall interface with various types of surveillance facilities. The ARTS IIIE shall receive target and weather messages from these facilities. These messages contain aircraft beacon code and position, weather location and intensity, and status information. The primary purpose of this data is to enable air traffic controllers to locate targets and hazardous weather areas. The ARTS IIIE interface with these surveillance facilities will be via the ASR/ATCRBS digitizers. These short-range radar surveillance system interfaces include the Sensor Receiver and Processor (SRAP) and the ASR-9. The ASR-9 to ARTS IIIE interface is via the SCIP which is identical in interface and function to the SRAP. These digitizers convert the outputs from ATCRBS and ASR series radar into digital format and combine the replies received from each aircraft to form target reports on each aircraft for each antenna scan. Weather messages are generated internally by SRAP and the ASR-9. Azimuth sync messages are sent by the SRAP to identify antenna position. The sector messages are transmitted every 1/32 of one antenna revolution and define the current sector being processed by SRAP.

10.1.2 ARTCC-ARTS IIIE Interface. The ARTS IIIE shall interface with one or more ARTCCS. This communication shall include all transmissions and responses performed by the ARTCC that is pertinent to the ARTS IIIE, including flight plan, track, test, response, and other messages. Flight plan-related messages shall include flight plans, amendments, and cancellations. Track-related messages are exchanged to initiate and effect the transfer or update of a track. Response messages accept, reject, or request retransmission of a message or response to a test message. Test messages are used to check the proper operation of the interface.

10.2 Reserved.

10.3 System Support Computer Interfaces. System Support Computer supports the development; test, and evaluation of system modifications and provides centralized national support to the ARTS IIIE. In order to perform these functions effectively, the equipment interfacing to the SSC shall, where appropriate, be identical to those at the ARTS IIIE facilities. In addition, there shall be several interfaces to equipment unique to the SSC that are used primarily for testing and field support.

The SSC shall interface with equipment and facilities for the purpose of developing, testing, and verifying system modifications in an environment that duplicates the field as close as possible. These interfaces are to equipment that are identical to field equipment. Most of this equipment will be collocated with the SSC at the FAA Technical Center.